BILL GATES: THE FUTURE OF PROGRAMMING

BYTE

HOT TECHNOLOGY
333-MHz Pentium IIs Put to the Test /p41

UNIX OR NT:
Which Wins for the Web? /p106

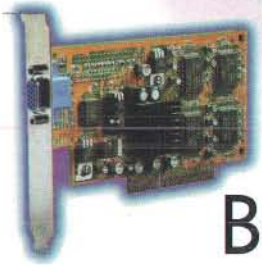
NETWARE 5
Gets It Right /p44

THE FUTURE OF INFORMATION TECHNOLOGY TODAY MARCH 1998 www.byte.com

net applications

REINVENTING THE WEB

XML AND DHTML WILL BRING ORDER TO THE CHAOS



26 3-D Graphics Boards Tested

news/ INTEL PROCESSOR ROAD MAP reviews/ IP MULTICAST, MICROSOFT TERMINAL SERVER, & MORE

International Edition
03>
9 770306 528034
£2.75 U.K./Lit.9,000 ITALY/ATS 67/$3.50 U.S.A.
A Publication of The McGraw-Hill Companies/0360-5280

Desktop Solutions

MICRON™ CLIENTPRO™ MRE

Intel 233MHz Pentium® processor with MMX™ technology
32MB SDRAM
2.1GB SMART Ultra ATA hard drive
15" Micron 500Lx, .28dp (13.7" display)

STANDARD FEATURES
512KB pipeline burst cache, DMI Compliant 2MB flash BIOS
16X ATAPI variable speed CD-ROM drive
3.5" floppy drive
Network Adapter w/Wake On LAN technology
S3 ViRGE graphics accelerator, 2MB EDO RAM
Advanced Hardware Monitoring and Power Management features
Chassis intrusion alert
Microsoft® IntelliMouse™†
Microsoft Windows NT® Workstation†
Intel LANDesk® Client Manager
5-year/3-year Micron Power® limited warranty

†Additional Microsoft software and operating system options available.

$1,549
Bus. lease $54/mo.

THE NEW MICRON CLIENTPRO 766Xi

Intel 266MHz Pentium II processor (features MMX technology)
64MB SDRAM
3.2GB SMART enabled Ultra ATA hard drive
17" Micron 700FGx, .26dp (16.0" display)

STANDARD FEATURES
512KB internal L2 secondary cache, DMI Compliant 2MB flash BIOS
24X ATAPI variable speed CD-ROM drive
3.5" floppy drive
Network Adapter w/Wake On LAN technology
4MB AGP 3D video
Creative Labs SoundBlaster™ 16-bit soundcard w/ speakers
Advanced Hardware Monitoring and Power Management features
Chassis intrusion alert
Microsoft IntelliMouse
Microsoft Windows NT Workstation†
Intel LANDesk Client Manager
5-year/3-year Micron Power limited warranty

†Additional Microsoft software and operating system options available.

$2,399
Bus. lease $84/mo.

Call for information on ClientPro Vxr. Prices start at $1,149.
Software upgrade may be required to achieve maximum transmission speeds. Software upgrades are available for download from Micron's Web page for free (www.micronpc.com).

Portable Solutions

MICRON TRANSPORT® VLX

Intel 166MHz Pentium processor with MMX technology
24MB EDO RAM (40MB max.)
1.6GB hard drive
16X modular CD-ROM drive
Li-Ion battery
12.1" TFT SVGA, 800x600 display

STANDARD FEATURES
256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG compatible
Zoomed Video-ready
Touchpad pointing device
Microphone and 16-bit stereo sound
2-way infrared port
Modular floppy drive
Microsoft Windows 95 and MS® Plus!
5-year/1-year Micron limited warranty

$2,249
Bus. lease $79/mo.

MICRON TRANSPORT XKE

Intel 266MHz Pentium processor with MMX technology
64MB EDO RAM
5GB removable hard drive
13.3" TFT XGA display

STANDARD FEATURES
512KB L2 pipeline burst cache
128-bit, 2MB DRAM graphics
20X CD-ROM drive with AutoPlay™ technology
Pick-a-Point™ dual pointing devices
Dragon NaturallySpeaking Personal voice recognition software
16-bit stereo sound and microphone
56K Fax/modem††
CardBus- and Zoomed Video-ready
2 infrared ports, S-Video, NTSC, game, USB port
Mobile Software Solutions
2 modular expansion bays
Custom nylon carrying case
Microsoft Windows 95 and MS Plus!
Microsoft Office 97 Small Business Edition
5-year/1-year Micron limited warranty

$4,599
Bus. lease $146/mo.

††Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

Server Solutions

MICRON NetFRAME® LV2000

Intel 233MHz Pentium II processor
32MB ECC SDRAM
2GB Ultra-Wide SCSI-3 hard drive
Microsoft Windows NT Server 4.0 (10-user license)
NOS Support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES
Single or dual Intel Pentium II processors
512KB integrated L2 cache in SEC package
ECC SDRAM (4 DIMM slots)
5 expansion slots: 4PCI, 1 ISA
Integrated Adaptec PCI Ultra-Wide SCSI-3 controller
Intel EtherExpress™ Pro 100 NIC controller
12-20X SCSI-2 CD-ROM drive
10 drive bays: 4 external 5.25"/1 external 3.5" 2 internal 5.25"/3 internal 3.5"
Intel LANDesk Server Manager v.2.8
Dedicated server technical support, 7x24
5-year/3-year Micron Power limited warranty
1-year next-business-day on-site service**

$3,499
Bus. lease $118/mo.

MICRON NetFRAME MV5000

Intel 300MHz Pentium II processor
64MB ECC SDRAM
4GB Ultra-Wide SCSI-3 hard drive
Microsoft Windows NT Server 4.0 (10-user license)
NOS Support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES
Single or dual Intel Pentium II processors
512KB integrated L2 cache in SEC package
Memory: ECC EDO or SDRAM option
9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
Dual integrated Symbios Ultra-Wide SCSI-3 controllers
Integrated Symbios Narrow SCSI controller
Intel EtherExpress Pro 100 NIC
Embedded RAID upgrade option
I-2O Ready via embedded Intel i960-RD
5 internal, hot-pluggable, hard drive bays (Upgradable to 10)
1 (one) 360 watt hot-pluggable power supply standard (Upgradable to 3)
Rack Adapter option
Intel LANDesk Server Manager v.2.8
Dedicated server technical support, 7x24
5-year/3-year Micron Power limited warranty
1-year next-business-day on-site service**

$5,699
Bus. lease $180/mo.

**On-site service for the NetFRAME servers is provided by Digital Equipment Corporation and is optional.

Micron backs you up. Each system is custom configured and shipped directly, so it meets your needs, not someone else's. If you have any PC or networking questions, call our award-winning 24-hour technical support. Buy Micron. And get the job done right.

MICRON POWER℠ WARRANTY

- 5-year limited warranty on microprocessor and main memory
- 3-year limited parts-only system warranty (1-year for TransPort systems)
- 1-, 2- or 3-year optional on-site service agreement for Micron desktop and server systems
- 30 days of free Micron-supplied software support for Micron desktop systems; 3 optional network operating system incident resolutions included for Micron server systems
- 30-day money back policy
- 24-hour technical support

The foregoing is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale may vary for specific configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.

Micron Sales Hrs: Mon-Fri 6am-10pm, Sat 7am-5pm, Sun 10am-5pm (MT)
Technical Support Available 24 Hours A Day, 7 Days A Week.
Toll-free from Mexico: 95-800-708-1755 • Toll-free from Canada: 800-708-1758 • Toll-free from Puerto Rico: 800-708-1756
International Sales: 208-893-8970 • International Fax: 208-893-7393

Designed for Microsoft® Windows®95

©1998 Micron Electronics, Inc. All rights reserved. Micron Electronics is not responsible for omissions or errors in typography or photography. All purchases are subject to availability. Prices and specifications may be changed without notice; prices do not include shipping and handling and any applicable taxes. 30-day money-back policy does not include return freight and original shipping/handling charges, applies only to Micron brand products and begins from date of shipment. All sales are subject to Micron Electronics' current terms and conditions of sale. Lease prices based on 36-month lease. The Intel Inside Logo and Pentium are registered trademarks and MMX is a trademark of Intel Corporation. Microsoft, Windows, Windows NT and the Windows logo are registered trademarks of Microsoft Corporation. Product names of Micron products are trademarks or registered trademarks of Micron Electronics, Inc. or NetFRAME Systems, Inc. Other product names used in this publication are for identification purposes only and may be trademarks of their respective companies.

MICRON GIVES YOU EVERYTHING YOU NEED FOR FULL NETWORK SOLUTIONS.

EVERYTHING YOU NEED TO BE ON TOP OF YOUR BUSINESS

AND THE RELIABILITY TO KEEP YOU THERE.

Build your network from the ground up with Micron Electronics' end-to-end networking solutions. Whether it's servers, portables or business desktops, Micron™ PCs are the top of the line. You get the hardware, software, and technical support you need at a price your business can appreciate. Our NetFRAME® MV5000 server offers enterprise features at a mid-range price, or the entry-level LV2000 gives you the reliability you require at a competitive price. Micron's network-ready ClientPro® desktops are what you've been looking for in business PCs, including the industry's best engineering and fail-safe remote and local management capabilities. The new ClientPro 766Xi takes business computing to the highest level of remote management, combined with easy network integration and outstanding reliability. And the Micron TransPort® portable features our award-winning TransPort XKE — with incomparable speed, features and power for the road. Or get the workhorse TransPort VLX for cutting-edge features at an impressive price. No matter which Micron computer you choose, you'll get award-winning 24-hour technical support and a limited warranty that's hard to beat. So get a Micron system now. And get wired for business.

MMX™ intel inside pentium II

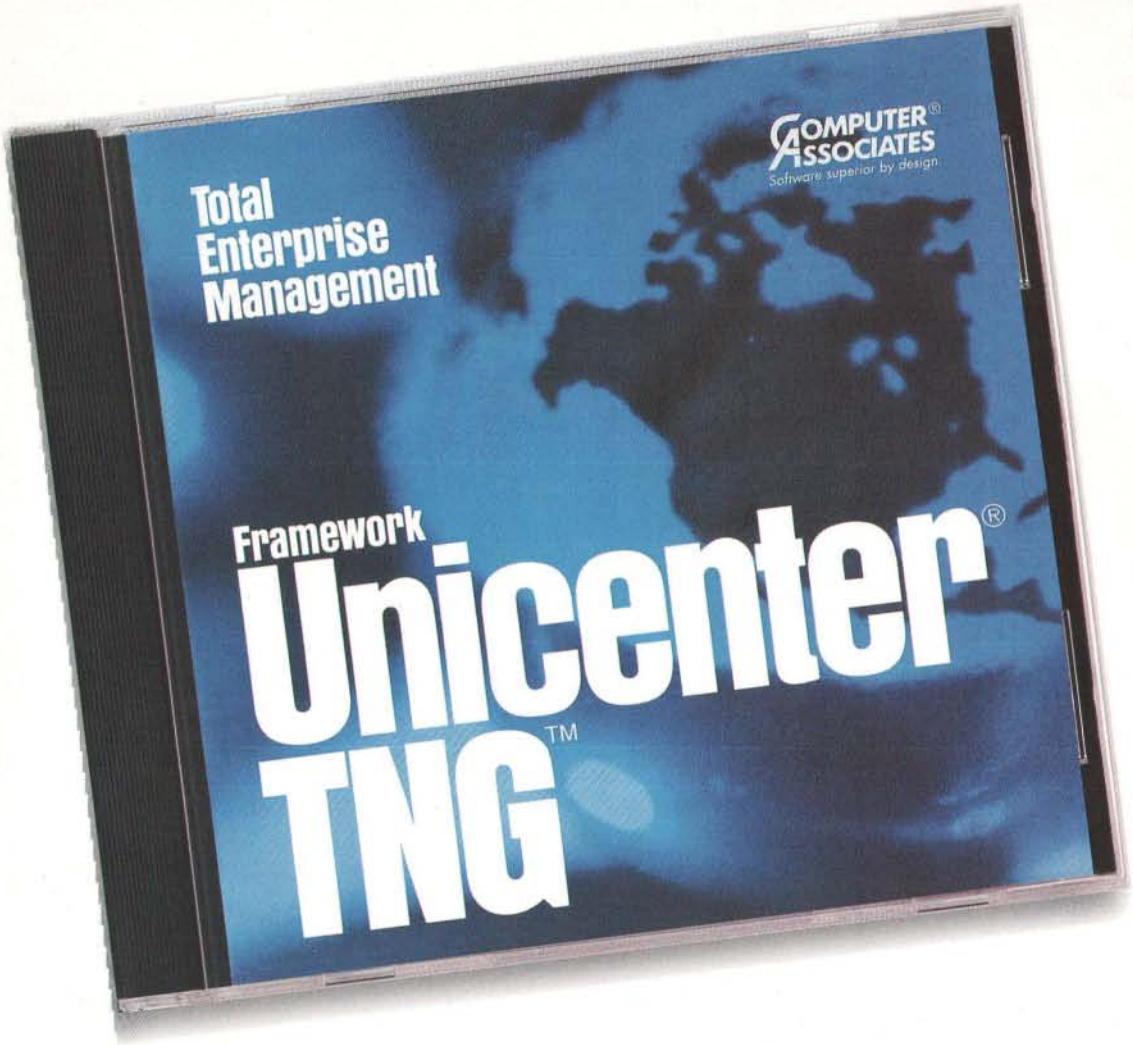
Call now to order.
800-362-7306
www.micronpc.com

MICRON ELECTRONICS™

Thinking Out Of The Box.™

Enter HotBYTEs No. 112 at http ://www.byte.com/hotbytes/

The Framework Is FREE.



For A FREE CD, Call 1-888-864-2368.

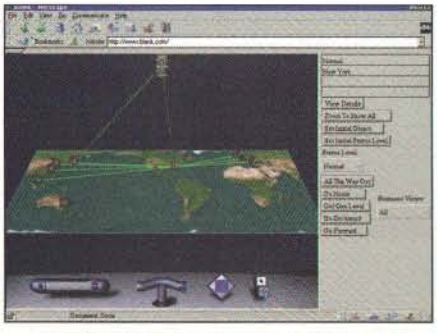
The Benefits Are Invaluable.

Time to market.

It's the biggest challenge every developer faces. But now there's something that can help you conquer it. An amazing new framework that will enable you to develop your applications much, much faster than before.

The Unicenter TNG Framework Can Save You Years Of Development Time.

The TNG Framework provides an instant foundation for virtually any kind of application you need to develop.



Unicenter TNG uses virtual reality to create a 3-D environment representing objects in the real world.

It provides all of the common services your applications will ever need. Basics like calendar management, object repository, and virus detection are just a few of the dozens of services that are included for free.

Sure, you could write your own but do you have countless months to do it? And would it be as robust as everything TNG can give you today? Not to mention, it would take even the most gifted developer a very long time to develop some of the very uncommon services the TNG Framework offers. Like a revolutionary 3-D interface that incorporates virtual reality. And innovative Business Process Views™ that let users look at their systems and processes any way they like.

	# Of Developers	Develop Time (mos.)	Person Mos.	With TNG Framework
2-D and 3-D User Interface	5	8	40	Available Now
Object Repository	8	12	96	Available Now
Auto Discovery	6	9	54	Available Now
Calendar Management	5	8	40	Available Now
Virus Detection	3	7	21	Available Now
Reporting	4	5	20	Available Now
Business Process Views	6	7	42	Available Now
Event Management	15	18	270	Available Now
Delivery Timeframe			583	SHIP Today

Why waste time? Unicenter TNG Framework can save you countless months.

Why spend the next five years building your applications from scratch, when you can use the Framework to get an edge on your competition today?

Unicenter TNG Framework Provides All Your Applications With Cross-Platform Support.

With the TNG Software Development Kit and FREE TNG training programs, you'll be able to develop for the broadest variety of UNIX and NT platforms. In fact, Unicenter TNG is the most open, interoperable, and scalable management solution available. Today, over a dozen companies are shipping the Unicenter TNG Framework with their systems. Companies like HP, DIGITAL, NCR, Tandem, SGI, Data General, SCO, and Fujitsu, to name a few. They ship it, so you don't have to.

Unicenter TNG Is Widely Recognized As The Industry Standard For Network And Systems Management.

Unicenter TNG is the only management solution that has been publicly endorsed by virtually every major hardware and software company including Microsoft, Sun, SAP, Intel, HP, DIGITAL, Tandem, NCR, SGI, and Data General. *Information Week* summed it up best when it recently said "Unicenter TNG is a generation ahead of the competition."

Call 1-888-Unicenter Today For Your FREE Unicenter TNG Framework, Or Visit www.theframework.com.

Call today and give yourself a free head start on every single application you develop.

It just might be the competitive edge you need. To finish first, every time.

COMPUTER ASSOCIATES®
Software superior by design.

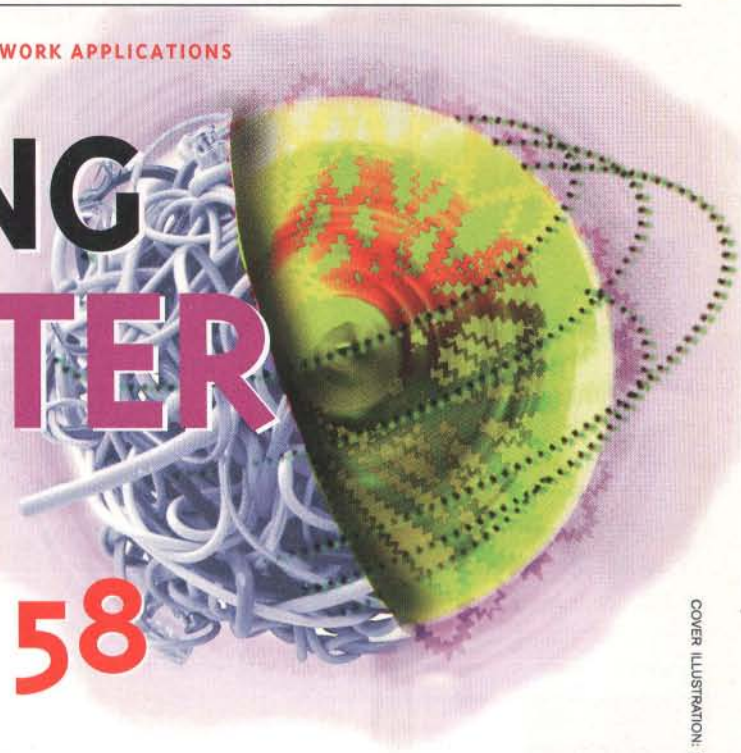
Unicenter® TNG™ Framework

©1997 Computer Associates International, Inc., Islandia, NY 11788-7000. All other product names referenced herein are trademarks of their respective companies.

BYTE
COVER STORY
March 1998, vol. 23, no. 3

BUILDING NETWORK APPLICATIONS

WEAVING a BETTER WEB



58

By Scott Mace, Udo Flohr, Rick Dobson, and Tony Graham

The Web is falling apart due to HTML's lack of essential features. But help is on the way.

COVER ILLUSTRATION: BRIAN DAY / FISHER & DAY © 1998

INTERNATIONAL

European ASIC Designs 40IS 7
By Dick Pountain
New design methods and processor architectures reduce the cost of developing embedded applications.

Webcasting Over the Air 40IS 11
By Valerie Thompson
More ways to access the Web are coming to homes in Europe.

Speedy Wireless Networks 40IS 15
By Stella Kao
10-Mbps wireless LANs can carry complex audio and video applications.

VBA and COM 70
By Bill Gates
Gates discusses his view of the future of application programmability.

TeraFLOPS Power 73
By Dick Pountain
Big problem to solve? First you get 9000 Pentium chips . . .

MANAGING DATA

Stored Procedures: Threat or Menace? 87
By Joe Celko and Jackie Celko
Stored procedures are fine—if you want to produce slow code.

Writing for Rhapsody 79
By Tom Thompson
Apple's latest OS offers a rich set of object-oriented frameworks for rapidly building GUI applications.

Amending Moore's Law 91
By Dick Pountain
Technology, finance, and physical law may force chip transistor density to level off.

EDITORIAL

14

INBOX

17

BITS

Pentium II in '98 24
Java Adoption Plans 26
Dual Analog Routers 32
GartnerGroup Report on ERP Software 34
Wanted: Programmers 40

EVAL

PENTIUM II PCs

Shooting the Rapids at 333 MHz

41

We test new systems from Compaq and HP.

REMOTE TERMINAL SERVER

Terminal Compromises

43

Windows-Based Terminal Server: a leap forward or a step back in time?

NETWORK OS

NetWare Enters the Nineties

44

NetWare 5 makes it easy to use TCP/IP for all network client communications.

LAB REPORT

SOFTWARE

The Best OS for Web Serving: Unix or NT?

106

By Barry Nance

Which operating system should you be running on your Web server? We tested NT and five Unixes to find out.

HARDWARE

Render Benders: 26 Graphics Cards for Fast 3-D

112

By Rob Hummel

Don't get left in the dust with a graphics engine that doesn't deliver.

WEB PROJECT

Perl and Apache

97

Apache's embedded Perl interpreter, mod_perl, integrates Web services with scripting.

JAVATALK

Object Marries Relational

101

Ardent's Java Relational Binding turns a relational database into a Java object-oriented database management system.

CHAOS MANOR

Doing Something About Microsoft

129

Jerry has some ideas about how to resolve the Microsoft/Justice flap. Plus, another encounter with Plug & No Play.

REVIEWS

IP MULTICAST SOFTWARE

Multicast Offers Bandwidth Salvation

121

Three for data broadcasting.

WEB ACCELERATOR

If You Build It, Will They Come?

125

Sitara rewrites TCP.

DIRECTORY SERVICES

Novell's New Directory Direction

126

With NDS for NT, Novell tries to solve a big problem.

OFFICE SUITE

OfficeMac: Worth Revisiting in 98

128

Microsoft restores Mac/Windows file compatibility.

WHAT'S NEW

153

Previews of a new Toshiba Satellite and Softimage's Digital Studio.

IMPROBABLE

Get to the Point

158

A product to end voice-mail hemming and hawing.

SERVICE

Product Information
http://www.byte.com/hotbytes/

Index to Advertisers
Alphabetical Order 150
Editorial Index by Company 152

CORE

OPERATING SYSTEMS

An OS for Information Appliances

45

By Tom Whittaker

Sun's Software Suite is a scalable set of OS and application components for hand-held and embedded devices.

NETWORKS

DCOM: Microsoft Enhances DCE

47

By Paul Clip

The Distributed Component Object Model is an object-oriented RPC architecture that's built on standards, yet it's extensible.

CPUs

A Flexible CPU for Digital Cameras

49

By Reynaldo Archide

The MIPS processor architecture offers ways to extend computing power for custom applications. LSI Logic used it to build a chip for digital cameras.

PROGRAMMING

Better Performance with Exceptions in Java

53

By David Orchard

You can use the language's runtime error checking to improve a program's performance.

DATABASES

The OQL Standard Emerges

55

By Daniel Evans

Object Query Language offers a good solution for complex data management and distributed object computing.

THE BYTE WEB SITE, HOTBYTES, and THE VIRTUAL PRESS ROOM

http://www.byte.com

PROGRAM LISTINGS

FTP: ftp.byte.com
From BIX: Join "listings/frombyte98" and select the appropriate subarea (i.e., "mar98").

BYTE (ISSN 0360-5280) is published monthly by The McGraw-Hill Companies, Inc. Publication office: 1221 Avenue of the Americas, New York, NY 10020. U.S. subscriber rate $24.95 per year. In Canada and Mexico, $34.95 per year. European surface-mail subscriptions $60, airmail $85. Non-European subscriptions, $60 surface mail or $85 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. Single copies $3.95 in the U.S., $4.95 in Canada. Executive, Editorial, Circulation, and Advertising Offices: 29 Hartwell Ave., Lexington, MA 02173. Periodicals postage paid at New York, NY, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Canada Post International Publications Mail Product Sales Agreement No. 246492. Registered for GST as The McGraw-Hill Companies, Inc., GST #123075673. **Postmaster:** Send address changes and fulfillment questions to BYTE Subscriptions, P.O. Box 552, Hightstown, NJ 08520.

Printed in the United States of America.

CONTENTS BY PLATFORM

WINDOWS

Deschutes: Pentium II Breakout 24
With the Deschutes processor, Intel hopes to bring the Pentium II to all kinds of PCs. Meanwhile, we cut through the confusion about this new CPU.

Shooting the Rapids at 333 MHz 41
We test two of the first 333-MHz Deschutes-based desktops: The Compaq Deskpro 6000 and the HP Vectra VL.

Terminal Compromises ... 43
Is Microsoft's Windows-Based Terminal Server just a return to the Seventies? Plus, a look at Citrix's innovative technology.

VBA and COM 70
The future of Windows software, according to Mr. Gates.

Render Benders: 26 Graphics Cards for Fast 3-D 112
To go along with OpenGL, Accelerated Graphics Port, and Direct3D, you might want one of these video boards. Our tests will help you choose.

Doing Something About Microsoft 129
Jerry encounters Plug & No Play—again—and offers advice on defragging disks under NT.

What's New 153
Previews of Softimage's video-editing system for NT and Toshiba's Satellite Pro 480CDT.

MACINTOSH

Writing for Rhapsody 79
Apple's elegant melding of OS and development environments endows Rhapsody with the capability to both provide and manage industrial-strength server services by pointing and clicking.

OfficeMac: Worth Revisiting in 98 128
Microsoft restores Mac/Windows file compatibility with the latest rev of Office 98 for the Macintosh. Our reviewer also finds that performance has been improved.

UNIX

The Best OS for Web Serving: Unix or NT? 106
We pit five Unix flavors—IBM AIX, Digital Unix, HP-UX, Sun Solaris, and Caldera OpenLinux—against NT as platforms for hosting Web servers.

JAVA

Survey Reveals Java Adoption Plans 26
BYTE readers tell us about their Java intentions, complaints, and development tools.

Better Performance with Exceptions in Java ... 53
One of Java's strengths is that it does extensive run-time error checking. You can use this feature to boost the performance of your Java programs.

Object Marries Relational 101
Rick Grehan checks out a unique package that provides a thin object language binding between a Java application and a relational database.

DATABASES

The OQL Standard Emerges 55
Object Query Language offers a good solution for complex data management and distributed object computing.

Stored Procedures: Threat or Menace? 87
Stored procedures violate database theory, can be inefficient, and may hinder portability. Use at your own risk.

Object Marries Relational 101
Ardent's Java Relational Binding appears to implement an object-oriented database, but it actually runs atop relational databases.

NETWORKS

Dual Modem Routers 32
Dual analog modems can quench your thirst for bandwidth without requiring you to install ISDN.

Terminal Compromises ... 43
Look, I've got terminals hanging off my Windows server.

NetWare Enters the Nineties 44
When the final release of NetWare 5 supports both TCP/IP and IPX clients, NetWare will be back as the world's most connectable network.

DCOM: Microsoft Enhances DCE 47
This RPC architecture brings location independence, language neutrality, garbage collection, and component versioning to distributed environments.

Weaving a Better Web 58
Organizing content, treating Web page elements as objects—HTML can't do it. But here comes help: XML, Dynamic HTML, and new style sheets.

TeraFLOPS Power 73
Just think if you had a server like this machine.

Perl and Apache 97
Think Web services with Perl are too slow? Try mod_perl, an embedded Perl interpreter.

The Best OS for Web Serving: Unix or NT? 106
Which operating system should you be running on your Web server? We test NT and five Unixes to find out.

Multicast Offers Bandwidth Salvation 121
Multicast products like these three can help you tame your IP application bandwidth hogs.

If You Build It, Will They Come? 125
Sitara's server and client products incorporate a transport protocol that fixes some of TCP's glaring problems. The promise is much faster downloads.

Novell's New Directory Direction 126
Novell Directory Services for NT extends NetWare's flexible directory services for use within existing Windows NT networks.

INDEX

ActiveX 58, 70
Apache 97
Applications development .. 58, 70, 79, 101
COM 17, 47, 70
CPUs 17, 24, 49, 73, 91
Cascading style sheets 58
Channel Definition Format .. 58
Components 45, 47, 70
Computer design 73, 91
Databases 17, 55, 87, 101
Desktop PCs 41, 153
Directory services 126
Distributed COM 47
Dual analog routers 24
Dynamic HTML 58
Embedded technology ... 45, 49
Enterprise resource planning 24
Extensible Link Language ... 58
Extensible Markup Language (XML) 58, 70
Extensible Style Language .. 58
Graphics cards 112, 153
HTML 58
Information appliances 45
Internet/Web .. 44, 58, 97, 106, 121, 125, 153
Intranets 44
Java 14, 24, 44, 53, 101
mod_perl 97
Moore's Law 91
Multicasting 121
Networking 24, 43, 44, 47, 58, 97, 121, 126, 153
OODBMS 101
Object Query Language 55
Office suites 128
Operating systems .. 17, 45, 79, 106, 129
Parallel processing 73
Pentium 24, 41, 73, 153
Perl 97
Programming ... 17, 40, 45, 53, 70, 79, 87, 97, 101, 153
Protocol data units 47
Relational databases ... 87, 101
Remote terminal servers 43
Rhapsody 79
SGML 58
Security 17, 126, 153
Simulation 73
Stored procedures 87
Supercomputing 73
TCP/IP 44, 121, 125
3-D graphics 112, 153
Web servers 106

www.byte.com

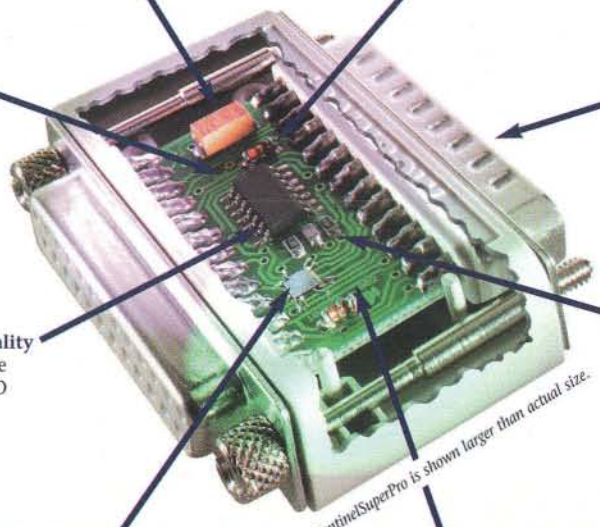
Reliability you can depend on
Sentinel keys are consistently the industry's most reliable, with performance records far better than any other hardware key.

A strong commitment to R&D
Rainbow invests 11% of its revenue in research and development to make the world's leading protection even better.

Quick and easy to implement
The **SentinelWizard**™ GUI is an innovative software tool that guides you easily through the implementation process.

Manage network licenses
NetSentinel is the only software protection to undergo rigorous testing by and receive approval from Novell.

yes NetWare Tested and Approved



SentinelSuperPro is shown larger than actual size.

ISO 9002 Certified FM# 30128

The industry's highest quality
Rainbow is the first software protection supplier with ISO certified quality standards.

Truly transparent protection
Designed to perform invisibly to end users, Sentinel automatically identifies system drivers and is transparent to peripherals.

NEXT GENERATION ASIC TECHNOLOGY

Superior security and flexibility
Proprietary ASIC technology, multiple encryption algorithms in a single key and more make Sentinel the most flexible and secure protection available.

Compatible with your software
Rainbow's partnerships with Apple, Microsoft and IBM ensure the security of your software on any platform today and in the future.

RAINBOW TECHNOLOGIES
MICROSOFT WINDOWS COMPATIBLE
Mac OS
Available and Ready for OS/2

Why Sentinel protects more software than all other dongles combined!

Over 11 million Sentinel® keys protect software worldwide. In fact, 55% of all protected software has a Sentinel key, from Rainbow Technologies.

Sentinel is easy to implement, transparent to your end-users and backed by the world leader. When you need on-time delivery and global support, you need Sentinel.

Only Sentinel gives you leading-edge technology, ISO 9002 certified quality and over 99.99% reliability.

Protect your software investment. Order a *Sentinel Developer's Kit* now. Each kit comes complete with technical documentation, software drivers, utilities and a Sentinel key.

Call the Rainbow office or distributor nearest you today or visit **www.rainbow.com**.

SENTINEL
Software Protection
The #1 solution to piracy

RAINBOW TECHNOLOGIES

TEL: (714) 450-7300 • **FAX:** (714) 450-7450 • **EMAIL:** sentinel@rainbow.com • **FRANCE:** (33) 1 41 43 29 00 • **GERMANY:** (49) 89 32 17 98 0 • **U.K.:** (44) 1932 579200

©1997 Rainbow Technologies, Inc. Sentinel, SentinelSuperPro & SentinelWizard are registered trademarks of Rainbow Technologies. All other product names are property of their respective owners.

ALGERIA: AFAK (213) 41 85 61
ARGENTINA: Agri-Aid, S.A. (54) 1 8030536
AUSTRALIA: LOADPLAN (61) 3 9690 0455
BELGIUM/LUXEMBURG: E2S (32) 9 221 0383
BRAZIL: MPS Sistemas Ltda. (55) 11 574 8686
BULGARIA: KSIMETRO (35) 92 79 1478
CENTRALAMERICA: SoftCopradom (502) 2 304106
CHILE: TOPsoft (562) 235 4456
CHINA (East): Shanghai Pudong Software Park Electronics Company (86) 21 6417 8626
CHINA (North): CSBS (86) 10 6217 7722 X2404
CHINA (Southern): Shenzhen Futech Research Co., Ltd. (86) 755 3205906
COLOMBIA: Construdata (57) 1 622 6011
CZECH REPUBLIC: ASKON Int'l (420) 231 036 52
ECUADOR: SOFTUNO S.A. (593) 4 308251
EGYPT: ZEDAN-ADS (202) 248 8994
GREECE: Byte Computer S.A. (30) 1924 1728
GUATEMALA: Soft Copradom (502) 2 304106
HONG KONG: AllaLink Tech. (852) 2333 0626
HUNGARY: Polyware Kft (36) 76 481 236
INDIA: ANC Engineering Co. (91) 11 4615680
INDONESIA: PT. PromptadeMitraSari (62) 21 375 186
IRAN: GAM Electronics (98) 21 87 44 001
ISREAL: BARAK (972) 3 5622976
ITALY: RFI BEKSA SPA (39) 23 36 23215
ITALY: Siosistemi (39) 30 24 411
JAPAN: Giken Shoji Co., Ltd. (81) 52 972 6544
JORDAN: CDG Engineering (962) 68 63 861
KOREA: Genesis Tech. (82) 2 578 3528
LEBANON: National Group Cons. (961) 1 322829
MALAYSIA: Eastern Systems Design (M) Sdn Bhd (60) 3 241 1188
MEXICO: Impex, S.A. de C.V. (52) 66 210 291
MORROCO: (212) 2 40 03 97
NETHERLANDS: IntroCom (31) 74 2430 105
NEW ZEALAND: Softwareimages (64) 09 3789730
PERU OpenSoft (51) 1 225 3077
PHILIPPINES: Mannasoft Tech. (63) 2 813 4162
POLAND: Chandrey Software (48) 22 44 18 40
PORTUGAL: COMELTA (351) 1 4725190
RUSSIA: Multisoft Int'l (7 095) 176 35 84
SAUDI ARABIA: ZEDAN (966) 2 665 1904
SCANDINAVIA: Perico A/S (47) 2249 1500
SINGAPORE: Systems Design (65) 747 2266
SOUTH AFRICA: SOFTSECURE (27) 11 887 3943
SPAIN: MECCO (34) 3 422 7700
SWITZERLAND: IBV AG (41) 1 745 92 92
SWIZERLAND: Safe Compact SA (41) 2421 5386
TAIWAN: Evershine Tech. (886) 2 8208925
THAILAND: Bus. Comp. Sys. (66) 2 319 4451
TUNISIA: Soft Info. Tech. (216) 17 19 486
TURKEY: BIMEKS, Ltd. (90) 216 472 0434
VENEZUELA: HRT-M Osers (58) 2 261 4282

©1997 Rainbow Technologies, Inc. Sentinel, SentinelLM, Sentinel Express and Sentinel Professional Services Group are trademarks of Rainbow Technologies, Inc. All rights reserved.

Enter HotBYTEs No. 109 at http ://www.byte.com/hotbytes/

SIEMENS
NIXDORF

REMPEN & PARTNER

The Intel Inside Logo and Pentium are registered trademarks and MMX is a trademark of Intel Corporation.

MMX™
intel inside
pentium®
PROCESSOR

Long live the notebook, long may it be a source of profit and pleasure.

But where to find a true prince of notebooks? One that's so easy to use and upgrade with the newest processor, extra hard disk or RAM capacity. One that makes possible multimedia presentations fit for a prince.

Like to find out more about the SCENIC Mobile and such a safe investment? Visit us at *www.scenic.de*

Anything else we can do for you?

Personal Computer

Siemens Nixdorf: User Centered Computing

Enter HotBYTEs No. 153 at http ://www.byte.com/hotbytes/

BYTE

March 1998, vol. 23, no. 3

EDITOR IN CHIEF
Mark Schlack
Lexington, MA, 781-860-6827
mark.schlack@byte.com

Editorial Assistant: Chrystie Terry
Lexington, MA, 781-860-6294, chrystie.terry@byte.com

EDITORIAL

EXECUTIVE EDITORS
International: Rich Friedman
Peterborough, NH, 603-924-2523
rich.friedman@byte.com

New Media: Jon Udell
Peterborough, NH, 603-924-2622
jon.udell@byte.com

MANAGING EDITOR
Jenny Donelan
Peterborough, NH, 603-924-2511
jenny.donelan@byte.com

WEST COAST
Bureau Chief/Features Editor:
John Montgomery
San Mateo, CA, 650-513-6809
john.montgomery@byte.com

NEWS
News Editor: David L. Andrews
Lexington, MA, 781-860-6296
dave.andrews@byte.com

Senior Editor: Rainer Mauth
Frankfurt, Germany, +49 69 5801 123
rainer.mauth@byte.com

Associate News Editor: Jason Krause
San Mateo, CA, 650-513-6931
jason.krause@byte.com

REVIEWS
Director: David Essex
Lexington, MA, 781-860-6299
dave.essex@byte.com

Technical Manager, BYTE Lab: Al Gallant
Lexington, MA, 781-860-6389
al.gallant@byte.com

Technical Editor: Michelle Campanale
San Mateo, CA, 650-513-6810
michelle.campanale@byte.com

Technical Editor: Russell Kay
Lexington, MA, 781-860-6207
russell.kay@byte.com

Technical Editor: Pete Loshin
Lexington, MA, 781-860-6830
pete.loshin@byte.com

Technical Editor: Dan Tanner
Lexington, MA, 781-860-6425
dan.tanner@byte.com

FEATURES
Senior Technical Editor at Large:
Tom Thompson
Lexington, MA, 781-860-6302
tom.thompson@byte.com

Senior Technical Editor:
Edmund X. DeJesus
Lexington, MA, 781-860-6959
ed.dejesus@byte.com

Senior Editor: Tom Halfhill
San Mateo, CA, 650-513-6915
tom.halfhill@byte.com

Senior Editor: Scott Mace
San Mateo, CA, 650-513-6833
scott.mace@byte.com

NEW MEDIA
Production Associate:
Joy-Lyn S. Blake

Web Site Applications Developer:
Dave Rowell

SENIOR RESEARCHER
Rowland Aertker
rowland.aertker@byte.com

ASSOCIATE TECHNICAL EDITORS
Dennis Barker, Cathy Kingery,
Warren Williamson

PRODUCTION
Production Coordinator:
James J. Perry

EDITORIAL ASSOCIATE
Linda Higgins
Peterborough, NH, 603-924-2689
linda.higgins@byte.com

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle
jerryp@bix.com

CONTRIBUTING EDITORS
Udo Flohr, Rick Grehan,
Stella Kao, Dick Pountain

CONSULTING EDITORS
Stephen Apiki, Raymond GA Côté,
Alan Joch, Stan Miastkowski,
Barry Nance, Roberta Pournelle,
Peter Wayner

DESIGN Peterborough, NH
Design Director: Charles Dixon III

Associate Design Director/Design & Photography: Sharon Price

Associate Design Director/Graphics:
Joseph A. Gallagher

Designers: Cindy Sands,
Donna Sweeney

VICE PRESIDENT/PUBLISHER
Kevin McPherson
Lexington, MA, 781-860-6020
kmcphers@mcgraw-hill.com

Publisher's Assistant: Lois Beninati
Lexington, MA, 781-860-6126

ASSOCIATE PUBLISHER
Michael P. Walsh
Lexington, MA, 781-860-6714
mike_walsh@mcgraw-hill.com

Associate Publisher's Assistant:
Jean Tenuta
Lexington, MA, 781-860-6516

ADVERTISING STAFF
(Domestic and International)
See listing on page 151.

Sales Support:
Kathi Andrick, 614-899-4909

LICENSING/ELECTRONIC REPRODUCTION
Copyrights Manager:
Faith A. Ellington, 603-924-2525
fax: 603-924-2602
faith_ellington@mcgraw-hill.com

FINANCE AND OPERATIONS
Director: Jack Casey

FINANCE
Senior Financial Analyst:
Charles Barber

Manager, Information Systems & Technology:
Peggy Dunham

Systems Administrator:
Mike Naglie

Junior Financial Analyst:
Jason Wanatick

CIRCULATION
Subscription Circulation Director:
Don Nicholas

Circulation Operations Manager:
Corrine L. Callahan

Newsstand Manager:
Vicki Weston

Marketing Manager:
Laura Pittman

Planning Manager:
Steve Masten

Circulation Coordinator:
Jill Wood

Back Issues: 603-924-9281
fax: 603-924-2683

ADMINISTRATION
Human Resources Administrator:
Pat Burke

HOW TO CONTACT THE EDITORS

We welcome your questions, comments, complaints, kudos, and submissions.
MAIN OFFICE: 29 Hartwell Ave., Lexington, MA 02173, 781-860-6336.
Peterborough: One Phoenix Mill Lane, Peterborough, NH 03458, 603-924-9281.
San Mateo: 1900 O'Farrell St. #200, San Mateo, CA 94403, 650-513-6912.
GERMANY/EUROPE: Emil von Behring Strasse 2, 60439 Frankfurt, Germany, +49 69 5801 123.
ELECTRONIC MAIL: Send to "editors@byte.com." Most BYTE editors and columnists also have individual addresses for easy access.
MCI: 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own names.
WEB: http://www.byte.com
U.S. fax: Editorial: 781-860-6522
Advertising: 603-924-7507
U.K. fax: +44 171 495 6734
SUBMISSIONS:
Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for lost manuscripts or photos.
Vendors: We welcome news of your new products; please call the News department or the Reviews department at the earliest possible date. We cannot be responsible for unsolicited product samples.
ARTICLE REPRINTS:
For information on: **Electronic:** Contact Faith Ellington, BYTE, at 603-924-2525. **Hard copy:** Contact Omar Salas, Reprint Services, at 612-582-3808.

SUBSCRIPTION CUSTOMER SERVICE

Inside U.S., 800-232-BYTE; outside U.S., +609 426 7676. E-mail-based customer service: mpcstsvc@mcgraw-hill.com; Web-based customer service: http://www.byte.com/admin/mpaddchg.htm. International subscribers may also contact our international customer-service facility in Galway, Ireland, by calling +353 91 752792 or via fax: +353 91 752793. **For a new subscription, 800-257-9402** U.S. only, E-mail: mporders@mcgraw-hill.com or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520. Subscriptions are $24.95 for one year, $49.90 for two years, and $74.85 for three years in the U.S. and its possessions. In Canada and Mexico, $34.95 for one year, $64.95 for two years, $87.95 for three years. Internationally, US$60.00 for fast surface delivery, US$85.00 for air delivery. Single-copy price is $3.99 in the U.S. and its possessions, $4.99 in Canada. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue.

PHOTOCOPY PERMISSION:
Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of $1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, $1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Ellington, copyrights manager, 603-924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

Copyright © 1998 by The McGraw-Hill Companies, Inc.

BYTE
A Division of The McGraw-Hill Companies

All rights reserved. BYTE and BYTE are registered trademarks of The McGraw-Hill Companies, Inc. Trademark registered in the United States Patent and Trademark Office.

Member Audit Bureau of Circulation

THE BYTE SITE

Home Page	http://www.byte.com/
Story Archive	http://www.byte.com/art/art.htm
Conference	http://www.byte.com/discuss/discuss.htm
Benchmarks	http://www.byte.com/bmark/bmark.htm
Virtual Press Room	http://www.byte.com/vpr/vpr.htm
Product Information	http://www.byte.com/hotbytes/
Media Kit	http://www.byte.com/media/kit.htm
Subscriptions	https://www.byte.com/orders/mporders.htm

OFFICERS OF THE MCGRAW-HILL COMPANIES: *Founder:* James H. McGraw (1860–1948).
Chairman and Chief Executive Officer: Joseph L. Dionne; *President and Chief Operating Officer:* Harold W. McGraw III; *Senior Vice President and General Counsel:* Kenneth M. Vittor; *Executive Vice President and Chief Financial Officer:* Robert J. Bahash; *Senior Vice President, Treasury Operations:* Frank D. Penglase; *President, Information Services Group:* Michael K. Hehir; *Group Vice President, Information Technology and Communications Group:* Kevin C. Harold.

A Reliable Internet & Intranet Solution Provider

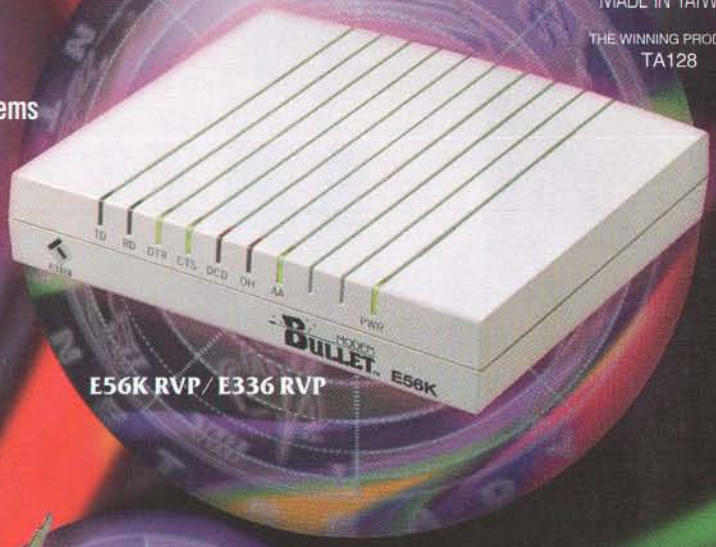
IT'S VERY WELL MADE IN TAIWAN

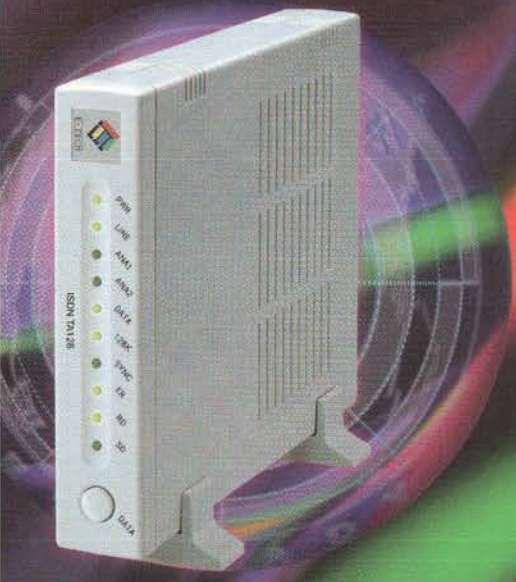
THE WINNING PRODUCT
TA128

33.6 / 56 Kbps

DATA / FAX / VOICE / SVD / SPEAKER PHONE / DSVD Modems

- Rockwell K56flex technology
- Data throughput up to 115.2 Kbps
- SVD / FDSP
- DSVD (Optional)
- Rockwell Video mode (VRPI) / V.80 Supported
- Plug & Play
- Wake-up Ring for PC
- Firmware Downloadable / Upgradable

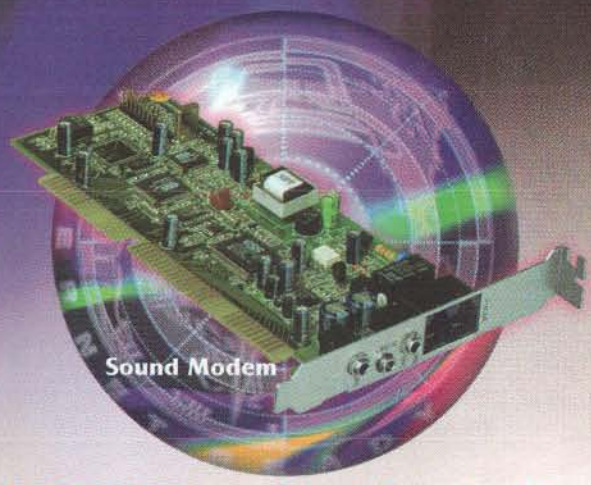




ISDN TA128

Features

- High Speed V.24 Data Port up to 230,400bps
- Multilink PPP (128Kbps)
- Two Analog Ports Supported
- Flash Memory Downloadable
- Multiple Subscriber Numbering
- BACP Protocol
- V.120 and V.110 Rate Adaptation
- X.25 on D Packet Data Application



ODM / OEM Enquiry Contact

E-TECH, INC.
Headquarters
30, R&D Road 2, Science Park Hsin-Chu, Taiwan, R.O.C.
TEL:886-3-577-4991
FAX:886-3-577-7751
BBS:886-3-577-5395
E-mail:service@ml.e-tech.com.tw
Web site:http://www.e-tech.com.tw

U.S.A. Sales
47400 Seabridge Dr., Fremont, CA 94538
TEL:(510)438-6700 · FAX:(510)438-6701
E-mail:sales@e-tech.com
Web site:http://www.e-tech.com

China Beijing Sales
TEL:86-10-6857-9101 · FAX:86-10-6857-9102

PTT Approvals

Germany BZT · Holland PTT · Denmark PTT · Sweden PTT · France Agrée

U.S.A. FCC · Australia Austel · Japan JATE · Italy PTT · U.K. BABT

See Us at
CeBIT98 HANNOVER
19. — 25. 03. 1998
Hall 15, F64

Enter HotBYTEs No. 150 at http ://www.byte.com/hotbytes/

©1998 Microsoft Corporation. All rights reserved. Microsoft, Windows, Windows NT and *Where do you want to go today?* are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

ications. how planning the when.

Something big just happened to Microsoft® Windows NT® Server. It's called Internet Information Server 4.0. It's big because it makes Windows NT Server the only OS with integrated Web and application services available out-of-the-box. What does that mean? It means that without further ado, you can start building lots of functionality-rich apps for your intranet. Within record time, without the blood, sweat and tears. So you're rolling out more reliable, scalable Web applications than ever before. And what's making it all happen is IIS 4.0—integrated with the component management, transaction services and message queuing of Windows NT Server. Suddenly, the future of Web servers is clear: the word is "Web applications" and the place to hang out is Windows NT Server.

Information and downloads: www.microsoft.com/iis/go/40/

Where do you want to go today?® **Microsoft**

Current customers of Windows NT Server 4.0, Windows NT Workstation 4.0 and Windows® 95 can acquire the Option Pack CD-ROM for approximately $99.95 from a local reseller or at no charge from http://www.microsoft.com/ntserver/ (connect-time charges may apply).

Uncommon Sense

Why the industry's current mania to divide up the world into proprietary camps won't work.

I want to congratulate BYTE readers for their common sense, a quality that's uncommon in today's computer industry. A recent survey by our research department shows that BYTE readers are more in touch with reality than most computer-industry executives when it comes to the Sun/Microsoft war.

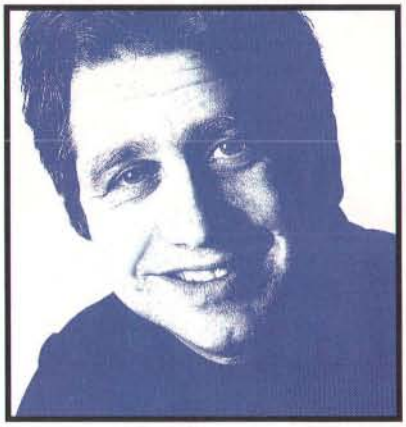
I've had a lot of back and forth with many of you on Java since I issued a call for standards. I've agreed with some that we should be careful to do this so the technology is not squelched. I also agree that Microsoft has not always been a good citizen in this market, but I stubbornly cling to the notion that Microsoft is not the greatest danger to Java. In the long run, the most likely outcome is that a major Java company will disagree with Sun, take its bat and ball, and go home. That's true even if Sun maintains its relatively high-minded approach. So, ultimately, the Java community needs its own way of resolving disputes.

BYTE set out to systematically discover what the first wave of Java evaluators thinks about the technology. You can read the full results on page 26. Nearly 300 people gave us their opinions about a wide range of issues, and we learned a lot about what these hardy pioneers think.

Judging from the survey, dreams of total control by one software company are foolish, at least for the late 1990s. Get over it, Bill. And you, too, Scott, Larry, and whoever else suffers from this malady.

The Java pioneers who answered our survey are among the best and brightest in computing. They must like what Sun has done—they overwhelmingly consider Java open—yet they want the technology turned over to a standards body. Here's a surprise: Two-thirds are doing their Java development principally on Windows NT, and they're going for multiplatform deployment. How can that be? The truth is that no one vendor has a solution for modern, large-scale computing.

Microsoft, for example, has a lot to prove about scale and scope before it can substitute for Unix across the board—it has its plate full just keeping Windows 95/98 from imploding under its own weight. Unix/Linux on the desktop, outside of technical computing, is not a solution for many people. Commercial Unixes are still much pricier than NT for servers, although for many they're a better value. Yet increasing numbers of NT server applications are driving down the cost of deployment. Java, in terms of reliability and applications support, is where Windows was 10 years ago. Yesterday's contenders—the Mac and OS/2—are still serviceable, but are they a more broad-based platform than Windows?



No one vendor has a solution for modern, large-scale computing.

Messy, isn't it? Diversity is the name of the game. Making diversity easier—not limiting it—should be the goal of all serious players for the foreseeable future.

That's why I'm glad that Sequent and Digital Equipment are cooperating to build a 64-bit Unix for Merced. It's worth pointing out that Sequent did more to get symmetric multiprocessing (SMP) up and running on the Intel platform than either Intel or Microsoft. Add to that Digital's background in 64-bit Unix on Alpha and in clustering, and you have a lot of know-how. They deserve Intel's support. In a strange way, they also deserve Microsoft's support; if you're buying a big SMP server to run 64-bit Unix, it's nice to know that it could also run 64-bit NT when that becomes available. That's a much better scenario than choosing between NT on a bitty box and Unix on a monster box.

Digital's alliances with Sequent and Intel suggest that the folks in Maynard have figured out that Digital is a computer company, not an Alpha company. Microsoft, which used to be exemplary in understanding it was a software company, seems to have regressed to a Windows company. Remember when IBM was an MVS-SNA-OS/2-PS/2 company? That was just before billions of dollars of red ink flooded Armonk. If it could happen to IBM, it could happen to anyone.

BYTE readers have spoken. Ultimately, I expect you'll hold the industry's feet to the fire: Make life in a mixed environment easier, or hit the road. And don't say we didn't warn you.

Mark Schlack

Mark Schlack, Editor in Chief
mark.schlack@byte.com

PHOTOGRAPH: KELLIE WALSH © 1998

Take the Genius Path to Success

Genius

BEST OF COMDEX BYTE CHOICE COMPUTEX Taipei '97
Finalist

IT'S VERY WELL MADE IN TAIWAN

NetMouse Pro

Surfing the Web with the True Internet Mouse

- Eliminate over 30% of mouse clicks and movements
- "Magic Button" & "Side-Button" will allow you to scroll up, down, left or right without moving the mouse
- Auto-browsing function allows you browse Web sites and Windows easily
- Use the "Side-button" & "Magic button" to switch between open applications and documents
- Supports Office 97 and Internet Explorer with new one-step zoom, fine-tune the zoom-in/out features by yourself
- Auto-panning features: press the Side-button once, move the mouse in the desired direction to go anywhere, plus Auto-Scrolling functions in eight directions

EasyScroll

Surf Through Windows and the Internet with Only a "Roller"

ColorPage-HR5

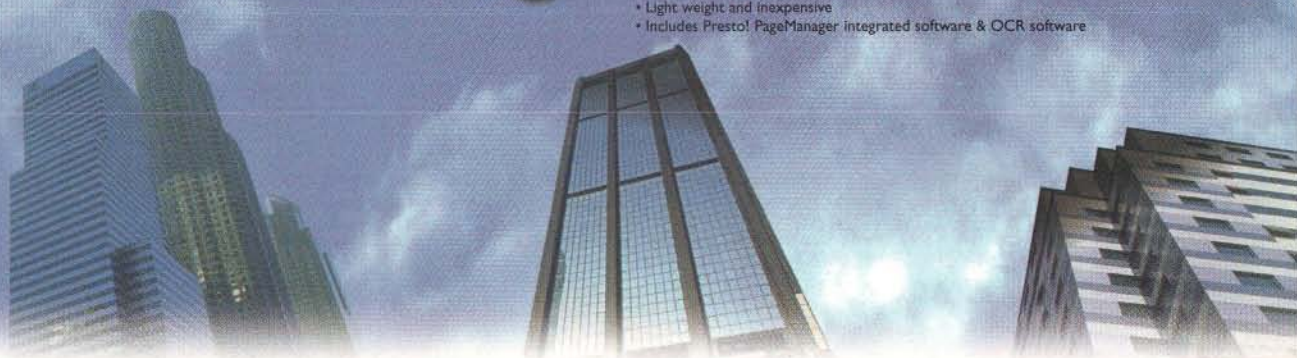
The Professional Scanning Solution

- 30-bit color flatbed scanner detects up to 1.07 billion colors
- SCSI interface for PC, and plug-in driver for MAC
- 600 DPI x 1200 DPI optical resolution for sharper images
- Sculpted shape and ergonomic design
- 9600 DPI software interpolation resolution
- Multi-language OCR software reduces re-typing of data
- Powerful image editing software ImagePals Go! and PhotoImpact SE (with WebExtensions)
- In WebExtensions use built-in web tools to create images, backgrounds, 3D buttons and GIF animations for Internet homepage design

ColorPage-Live

Perfect in Home Surroundings

- 30-bit true color scanner detects up to 1.07 billion colors
- Optical resolution 300 x 600 DPI, up to 4800 DPI through software interpolation
- Plugs right into the parallel port
- Light weight and inexpensive
- Includes Presto! PageManager integrated software & OCR software



KYE
Knowledge · Yield · Excellence

Genius is a registered trademark of KYE Systems Corp. All other products, brands or companies mentioned are trademarks or registered trademarks of their respective companies. Products may look different than shown here. Specifications are subject to change without prior notice.

KYE Systems Corp.
No. 492 Chung Hsin Rd., Sec. 5,
San Chung, Taipei Hsien,
Taiwan, R.O.C.
Tel: (886) 22 995-6645
Fax: (886) 22 995-6649
Web site:
http://www.geniusnet.com.tw

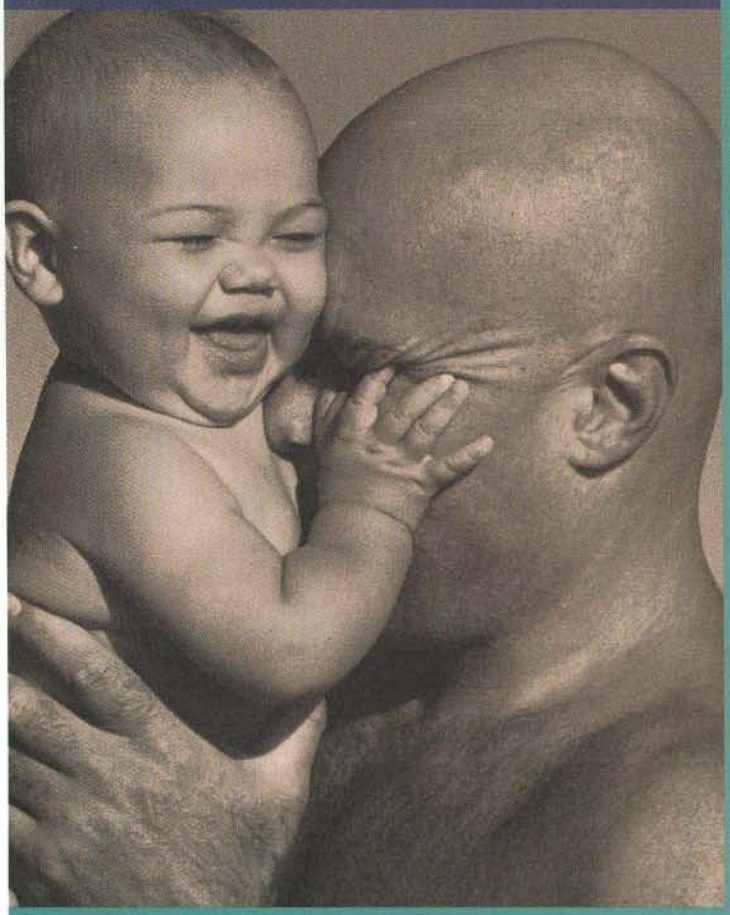
CeBIT 98
HANNOVER
19th–25th, Mar. 1998
Hall 9, C14

Let's Bring the Future Together

Enter HotBYTEs No. 156 at http ://www.byte.com/hotbytes/

HASP®

Protects Your Software



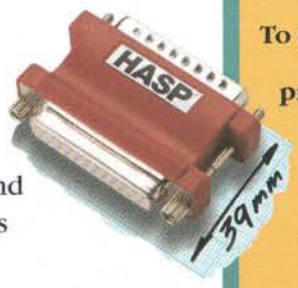
Your software is your baby – and you want to look after it. You created it, you developed it, you saw it right through to the moment it was ready for market. Now protect it. 50% of business software is stolen; $11 billion of developers' income is lost to piracy.* Is your software a statistic?

All over the world, more developers are protecting against piracy. They're protecting more products, on more platforms, with more security – and selling more as a result. And more of these developers are protecting with HASP.

To see why 25,000 developers worldwide protect with Aladdin, call and order your HASP Developer's Kit now!

HASP – The Professional Software Protection System®

- Rated #1 in industry tests
- Unequalled security
- Unparalleled flexibility
- Genuine ease-of-use and transparency
- Supported under Windows 95, 98 and NT, Mac, OS/2, NEC, UNIX, and LANs
- ISO 9002 quality and reliability
- New – USBHasp!



HASP Protects More

See us at Cebit – March 19-25, Hall 23 Stand D41

North America	**Aladdin Knowledge Systems Inc.** 800 223-4277, 212 564-5678, Fax: 212 564-3377, Email: hasp.sales@us.aks.com
Int'l Office	**Aladdin Knowledge Systems Ltd.** +972 3 636-2222, Fax: +972 3 537-5796, Email: hasp.sales@aks.com
Germany	**Aladdin Knowledge Systems Gmbh & Co. KG** +49 89 89 42 21-0, Fax: +49 89 89 42 21-40, Email: info@aladdin.de
UK	**Aladdin Knowledge Systems UK Ltd.** +44 1753 622266, Fax: +44 1753 622262, Email: sales@aldn.co.uk
Japan	**Aladdin Japan Co., Ltd.** +81 426 60-7191, Fax: +81 426 60-7194, Email: sales@aladdin.co.jp
France	**Aladdin France SA** +33 1 41-37-70-30, Fax: +33 1 41-37-70-39, Email: info@aladdin.fr
Benelux	**Aladdin Software Security Benelux B.V.** +31 24 648-8444, Fax: +31 24 645-1981, Email: sales@aladdin.nl
Russia	**Aladdin Software Security R.D. Ltd.** +7 095 923-0588, Fax: +7 095 928-6781, Email: aladdin@aladdin.msk.ru

1-800-223-4277

www.aks.com

ALADDIN®

The Professional's Choice

■ **Australia** Conlab 03 98985685 ■ **China (Beijng)** Feitian 010 62567389 **(Hong Kong)** Hastings 02 5484629 **(Shenzhen)** Hastings 0755 2328741 ■ **Czech** Atlas 02 766085 ■ **Denmark** Berendsen 039 577316 ■ **Egypt** Zeineldein 02 3604632 ■ **Finland** ID-Systems 09 8703520 ■ **Greece** Unibrain 01 6756320 ■ **India** Solution 011 2148254 ■ **Italy** Partner Data 02 26147380 ■ **Korea** Dae-A 02 8484481 ■ **Mexico** SiSoft 091 80055283 ■ **Poland** Systherm 061 480273 ■ **Portugal** Futurmatica 01 4116269 ■ **Romania** Ro Interactive 064 140383 ■ **Singapore** ITR 065 5666788 ■ **South Africa** D Le Roux 011 8864704 ■ **Spain** PC Hardware 03 4493193 ■ **Sweden** Kordab 455 307 300 ■ **Switzerland** Opag 061 7169222 ■ **Taiwan** Teco 02 5559676 ■ **Turkey** Mikrobeta 0312 4670635 ■ **Yugoslavia** Asys 021 623920

© Aladdin Knowledge Systems Ltd. 1985-1998 HASP-ad (1.98) 1.0-A1011 HASP is a registered trademark of Aladdin Knowledge Systems Ltd. All other product names are trademarks of their respective owners.

* 1997 BSA/SPA Study

inbox

Beyond the 32-Bit Operating System

I read "Beyond Pentium II" (December Cover Story) with great interest. I wonder what corresponding "radical" changes the IA-64 architecture means for operating systems, especially Microsoft Windows? Given the time frame and sponsorship, the introduction of IA-64 will have to coincide with a new OS, perhaps even one fundamentally rethought! Undoubtedly, the view from Redmond might be an important follow-up article.

Lynn Hopffgarten
hopffgarten@knight-hub.com

IA-64 will require a new 64-bit OS. The current 16- and 32-bit versions of Windows will still run on IA-64, of course, but only in x86 backward-compatible mode. The performance will be less than what you'd get from the best x86 processors available at the time Merced ships. To get the most from IA-64, you'll need a new 64-bit OS and new 64-bit applications.

Microsoft is already working on a 64-bit version of Windows NT. I think it's unlikely that Microsoft will port any other OS to IA-64; the current line of Windows 95/98 will always run on x86.

On the Unix front, SCO is working on UnixWare 64 with assistance from Hewlett-Packard, HP is working on its own 64-bit HP-UX, Digital is adapting its version of Unix, and Sun is porting Solaris to IA-64.

We'll have more articles on this subject as information becomes available.
—Tom Halfhill, senior editor

EPIC Flaw

I'm not so convinced of Intel's Explicitly Parallel Instruction Computing (EPIC) idea. Long instruction word (LIW) didn't get a bad name out of malice; the idea didn't work. It was an extension of the early RISC notion of making the compiler schedule to the pipeline, a bad idea because much parallelism is possible to discover only at run time, and recompiling every time a new microarchitecture is designed is a nonstarter. (Think of the time it took before we saw applications with Pentium-specific code.)

I'm betting on PowerPC to deliver performance in the short term. The PowerPC 750 is theoretically less superscalar than the 604e/Pentium II generation, yet it's faster. Why? More attention paid to making sure it does get close to its peak throughput rate through better memory architecture, better speculative execution, etc. Translate these gains to a design that can dispatch four or more instructions per clock at 500 MHz plus, which is what I expect of the PowerPC G4, and you're talking real speed. Check out IBM's Power3 design for a hint of what's to come.

Philip Machanick
Dept. of Computer Science
University of the Witwatersrand
South Africa

The PowerPC 750 is impressive. The latest Power Macs bear this out with their performance—higher than any single-processor x86-based PCs, according to some benchmarks. In the long term, however, I still have doubts that RISC vendors will be able to keep up with Intel. Without high-volume sales, it's hard to justify the expensive R&D it takes to compete. It will be interesting to see how often IBM and Motorola introduce new PowerPC cores in the years to come. I suspect they have enough new designs in the pipeline to last for a couple of years; beyond that, it gets fuzzy. I hope, for the sake of competition, the PowerPC doesn't die. Look for our story on the Power3 in the Core section of the April issue. —Tom Halfhill

Lose an Opcode?

What I don't get about IA-64 is why all instructions that rely on the speculative check can't make an implicit speculative check themselves and report an exception just as a pure speculative check may need to do. This would do away with that opcode. I find the check instruction most inefficient.

Ernesto A. Pérez
Isabela, Puerto Rico

The speculative check instruction must be separate from the speculative load because the CPU can't always determine the validity of the data when speculatively loading it from memory. The load may or may not cause an exception. Often, the CPU won't resolve that outcome until several instructions later, after a branch. Further-

HOW TO CONTACT US

ON THE WEB
Visit The BYTE Site! Search our archives. Download articles. See industry press releases. Join on-line conferences with other BYTE readers! See http://www.byte.com.

BY FAX
781-860-6522

BY E-MAIL
Address letters to editors@byte.com. To reach individual BYTE editors, see The BYTE Site on the Web for a directory. Letters may be edited for publication.

BY POST
Editors, BYTE, 29 Hartwell Ave., Lexington, MA 02173

SUBSCRIPTION CUSTOMER SERVICE
U.S. only: 800-232-2983; international: 609-426-7676; or see http://www.byte.com/admin/mpcstsvc.htm.

For advertising and other noneditorial contacts, see pages 151 or 10 or click on the information links on The BYTE Site.

more, it wouldn't save time to combine the speculative load and the speculative check in a single instruction. Checking for the exception would lengthen the execution time of the load instruction. It's better to separate them so the compiler has more flexibility to schedule them in parallel with other instructions. —Tom Halfhill

How To

I enjoyed reading "HTTP Authentication" (January Web Project), but I have one question. What is the Java function that converts a string from Base-64?

David Levitan
wizardofoz@iname.com

```
import
sun.misc.BASE64Decoder;
BASE64Decoder decode =
 new BASE64Decoder();
byte[] bDecoded =
 decode.decodeBuffer
 (sAuth);
sCredentials = new
 String(bDecoded,256);
```

—Jon Udell, executive editor

The ODBCDirect Connection

Thanks for Rick Dobson's articles "Using ODBCDirect's Advanced Features" and "Fast and Flexible Access to Databases" (September and August Core/Programming). Until recently I have used Jet for ODBC work. A few months ago I was given a task to hit a legacy database that had huge tables. Jet was swamped, so I started using Passthrough SQL, but I lost Data Access Object (DAO) flexibility when working with the remote tables. I was starting to feel the pressure when I remembered your articles and tried ODBCDirect with your examples as a launching point. I now have a great connection to my legacy data source, and the comfort of DAO for all the recordsets. Just what I needed, just in time!

Ted Finley
tfinle@corp.atl.com

Vulnerable NCs

"Back to the Future with 9 Network Computers" (December Hardware Lab Report), your nice review of the state of network computers, found that the Neoware product was pretty good. I agree. I've installed 15 as X terminals on a couple of our subnets.

However, there is a serious flaw in current NC products: lack of an SSH (secure shell) client. Without SSH or the equivalent, things such as log-in passwords can be sniffed on insecure networks—certainly every campus network—and any log-in from such a network computer can be cracked with ease. Any vendor's X terminals that don't do encryption are vulnerable. If an NC is competing against low-end PCs, it loses when the problem of network security must be solved.

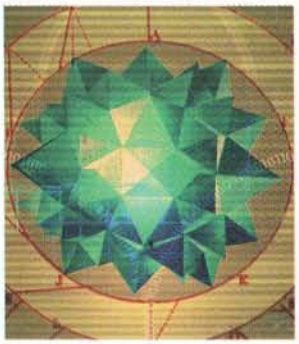
Technically, the remedy is simple: Just add SSH to the NC's OS. Let's hope vendors do so. Without it, our academic users cannot log-in to some of their own subnets without compromising them.

George Planansky
Manager, Computer Services Group; Division of Engineering and Applied Sciences
Harvard University

None of the vendors of Unix-capable NCs surveyed in our Lab Report plans to add SSH at this time. One reason NC vendors have been slow to grapple with the issue is lack of demand, suggests Gartner Group analyst Audrey Apfel. To date, most NCs have been deployed in trusted networks. —Editors

C++ Interface Representation

In "COM+: The Next Generation" (December), author David Chappell asserts that



C++ "currently has no standard way to specify interfaces." Abstract base classes, or classes consisting of pure virtual methods, are excellent interface representations. I wonder what Mr. Chappell could have meant. Certainly no extension to C++ is needed to provide this functionality.

Andrew Broadstone
andrewb@connected.com

You are absolutely correct—abstract base classes are excellent interface representations for C++ objects. They're not perfect, though, as a mechanism for defining interfaces to COM objects. From what Microsoft has shown us so far, the company plans to add to C++ syntax specifically focused on defining COM (and COM+) object interfaces.
—David Chappell

Have Clipboard, Will Travel

I don't know if Microsoft has any ambition to receive an ISO 9000 approval ("Components Battling Components," November), but it seems that the company has a long way to get there. I would enjoy taking part in an ISO 9000 inspection of Microsoft's software development process. Keeping track of all versions of various software components is crucial to those of us trying to ensure high quality.

Walter Krambring
Stockholm, Sweden

The Space in Space

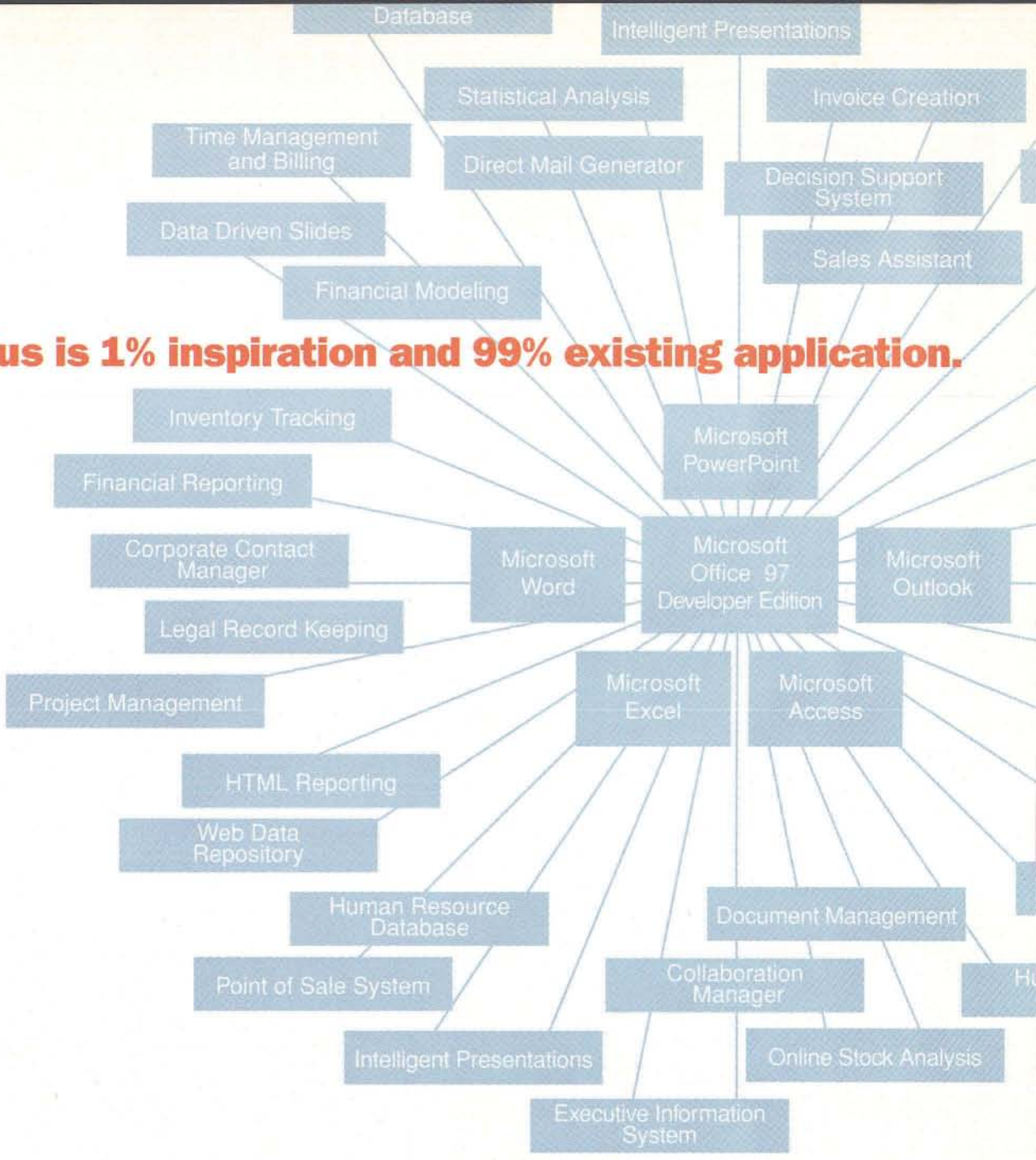
I'm appalled that anyone would plan to launch the number of satellites discussed in "Fiber in the Sky" (November Cover Story). Assuming all launches are successful and the machines stay in the right orbit, what happens to the poor radio astronomers who depend on an ability to see into a pollution-free sky? After the 10- or 15-year life span of this new "flying Internet," the retirement of the hardware is going to be an interesting meteor shower.

Lance Weber
lweber@stratos.net

Beta Blues

John McMinn's letter (December Inbox) prompted me to write to offer support for his argument. It seems that most PC software vendors are demanding payment for beta-release items with the implicit promise of "service packs" somewhere down the line. I don't buy a Taurus in the hope that Ford will release a modification to get the brakes working in six months. Why should I put up with that kind of marketing from Microsoft, Lotus, Corel, et al? Maybe if we all remember that we're being

ILLUSTRATION: PAUL WATSON © 1997



Genius is 1% inspiration and 99% existing application.

Well, maybe Edison said it differently. But he wouldn't if he'd had a copy of Microsoft® Office 97, Developer Edition. It enables you to turn Microsoft Office applications into hundreds of fully customized solutions without starting from scratch. The Microsoft Visual Basic® for Applications development environment is one you're familiar with so you'll be up and coding just as soon as you get the shrink-wrap off. And with Microsoft Office currently residing on millions of desktops worldwide, you'll be sure to find a market for your work. For more info about Microsoft Office 97, Developer Edition go to www.microsoft.com/officedev/

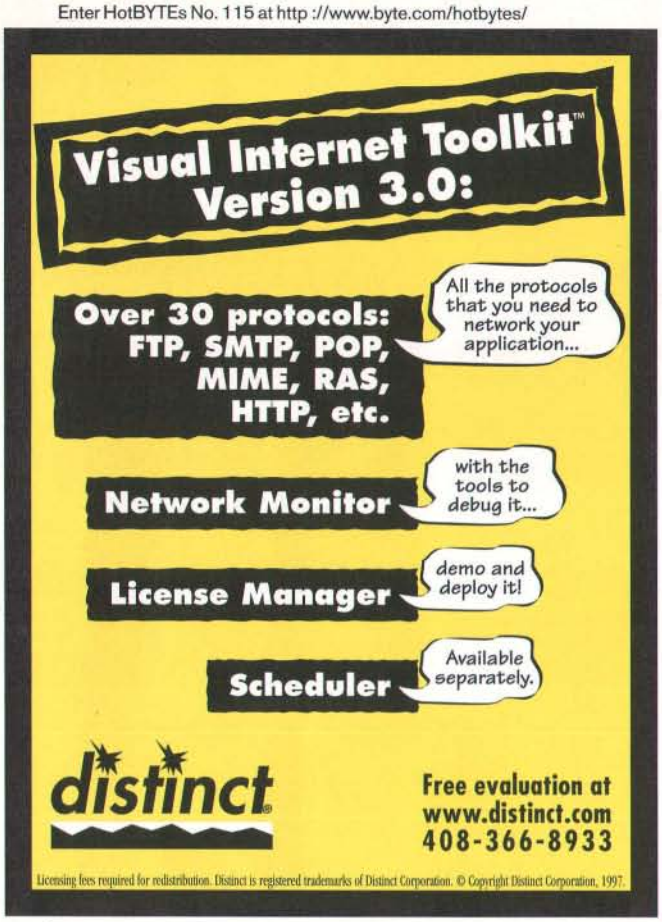
Featuring Microsoft® Visual Basic® Technology

Microsoft®

Where do you want to go today?®

©1997 Microsoft Corporation. All rights reserved. Microsoft, Access, Excel, Office 97 Developer Edition, Outlook, PowerPoint, Visual Basic, Visual Basic for Applications logo, Word, and *Where do you want to go today?* are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. To order any of the Microsoft Visual Tools, or to receive a reseller referral, in the United States or Canada, please call (800) 621-7930, Monday through Friday (7:00 a.m. to midnight, Eastern time), Saturday (8:00 a.m. to 8:30 p.m.), and Sunday (8:00 a.m. to 7:00 p.m.). Outside the U.S. and Canada, please contact your local Microsoft subsidiary. TT/TDD available at (800) 892-5234.

Enter HotBYTEs No. 115 at http ://www.byte.com/hotbytes/



forced to buy not marvelous new versions but plain shoddy merchandise, it will lead to a sea change in customer attitudes.

Paul Harper
IT Manager, British Council
Bangkok, Thailand

We agree that reliability is an important issue for all of us. That's why we're devoting next month's cover story to crash-proof PCs.
—Editors

FIXES

In the performance chart on page 116 of the review "Do You Hear What I Say?" (January), the bar labeled ViaVoice/Word should have been labeled ViaVoice/SpeechPad.

In "The Value of Free Software" (December Web Project), we failed to attribute the Web-server market share data on page 109; the source is Netcraft, http://www.netcraft.com/survey/.

Due to a typographical error in "Déjà Vu All Over Again" (November), we described the Out of Band (OOB) attack as affecting port 80; the connection is to port 139, a NetBIOS port.

COMING UP IN APRIL

COVER STORY
Why Do PCs Crash?
More important, how can we make them crash less often? Can the reliability of mainframes and critical embedded systems be brought to PCs? We explore what's being done to make PCs more dependable.

NETWORK INTEGRATION
Two Heads Are Better Than One
Clusters, multiprocessing, storage area networks: the new boons to fault resilience, scalability, and performance. BYTE examines what each solution brings to these three critical areas.

MANAGING DATA
Michael Stonebraker Manifesto
The creator of object-relational databases speaks out on OR technology and the future of thin clients and fat databases.

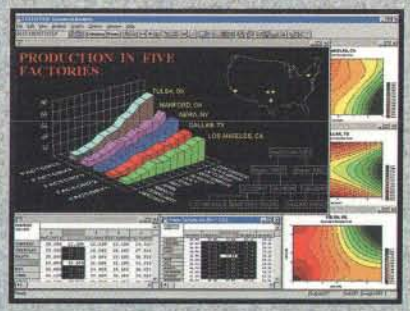
HARDWARE LAB REPORT
Color Laser Printers
Can the current crop of network color laser printers handle the demands of the business environment?

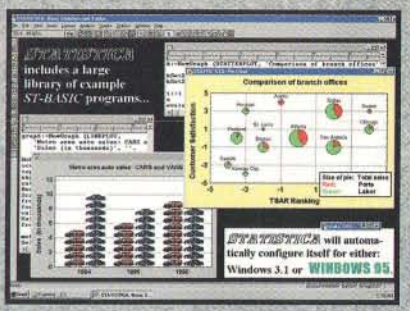
SOFTWARE LAB REPORT
E-Mail Servers for the Enterprise
We test IMAP-compliant e-mail servers, including Lotus Domino Mail, Microsoft Exchange Server, Netscape Messaging Server, and others.

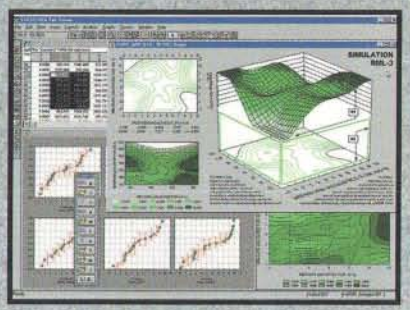
REVIEWS
Coming: The 30-GB Hard Drive?
IBM's giant magnetoresistive (GMR) head technology promises a threefold boost in data density. We test one of the first GMR drives, the 16-GB DeskStar.

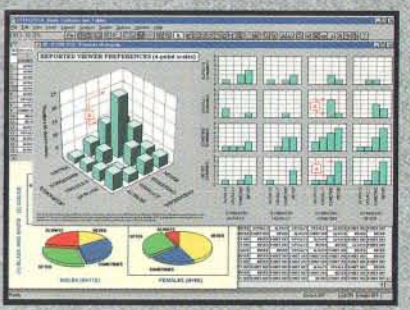
Enter HotBYTEs No. 116 at http ://www.byte.com/hotbytes/

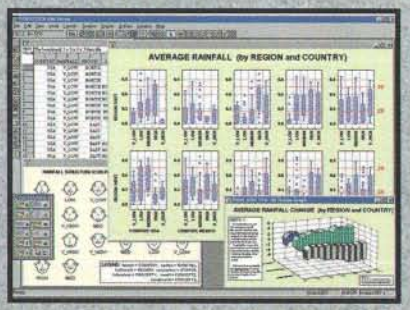
STATISTICA

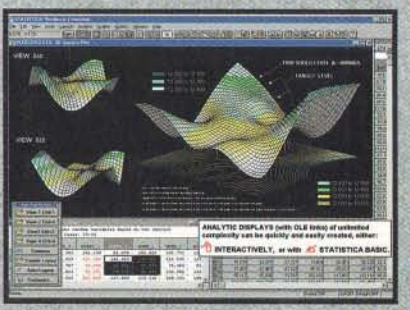


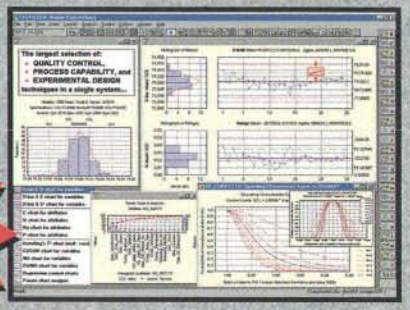


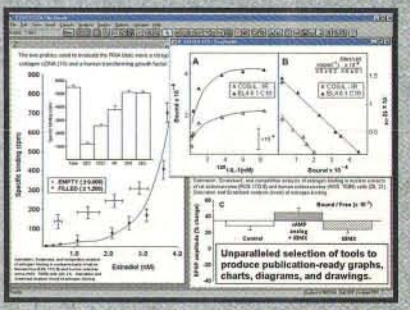


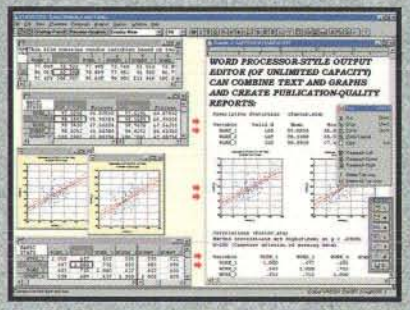


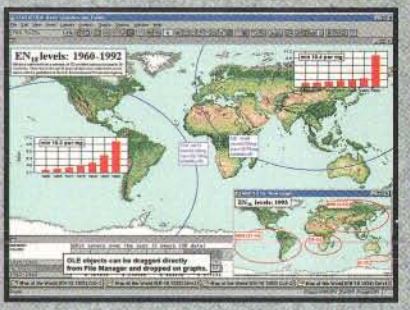












STATISTICA (automatically configures itself for *Windows* 95/NT [long file names, etc.] or 3.1) ■ A complete data analysis system with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Comprehensive *Windows* support, OLE (client and server), DDE, customizable *AutoTask* toolbars, pop-up menus ■ Multiple data-, results-, and graph-windows with *data-graph* links ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; variance components; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; classification tress; canonical correlation; item analysis/reliability; correspondence analysis; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with *Monte Carlo* simulations; and much more ■ On-line *Electronic Manual* with comprehensive introductions to each procedure and examples ■ Hypertext-based *Stats Advisor* expert system ■ Workbooks with multiple *AutoOpen* documents (e.g., graphs, reports) ■ Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, *Drag-and-Drop, AutoFill, Auto-Recalculate,* split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) ■ Powerful *STATISTICA BASIC* language (professional development environment) with matrix operations, full graphics support, and interface to external programs (*DLLs*) ■ Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating *Auto Task* toolbars ■ All output displayed in Scrollsheets™ (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, virtually unlimited ANOVA designs) ■ Megafile Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. *ODBC* access to virtually all data bases and mainframe files) ■ Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graph types and add them permanently to menus or toolbars ■ On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, *Multiple-Graph AutoLayout Wizard,* templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price **$995.**

Quick STATISTICA (for Windows) ■ A subset of *STATISTICA*; comprehensive selection of basic statistics and the full analytic and presentation-quality graphics capabilities of *STATISTICA* ■ Price **$495.**

STATISTICA Industrial System (requires *STATISTICA* or Quick *STATISTICA*) ■ The largest selection of industrial statistics in a single package; quality control charts (real-time data acquisition options), process capability analysis, R&R, Weibull Analysis, sampling plans, and an extremely comprehensive selection of experimental design (DOE) methods ■ Flexible tools to customize and automate all analyses and reports (incl. "turn-key" system options, and tools to add custom procedures) ■ Price **$995.**

NEW **STATISTICA Neural Networks** (interfaces with, but does not require *STATISTICA*) ■ The most comprehensive NN application available on the market ■ Price **$795.**

STATISTICA/Mac (for Macintosh) ■ Price **$695** (Quick - **$395**).

Overseas prices vary. Domestic sh/h $12; 30-day money back guarantee.

STATISTICA has received the highest rating in EVERY comparative review of statistics software in which it was featured, since its first release.

Over 3 Hours of Multimedia, Animated Overviews and Examples

StatSoft®

2300 East 14th Street • Tulsa, OK 74104 • (918) 749-1119
Fax: (918) 749-2217 • WEB: http://www.statsoft.com
e-mail: info@statsoft.com

StatSoft Ltd. (London, UK), ph: +44 1234 341226, fax: +44 1234 341622
StatSoft GmbH (Hamburg, Germany), ph: +49 40/468866-0, fax: +49 40/468866-77
StatSoft France (Paris, France), ph: +33 01-45-185-999, fax: +33 01-45-185-285
StatSoft Polska Sp. z o.o. (Krakow, Poland), ph: +48 12-391120, fax: +48 12-391121
StatSoft Italia (Padova, Italy), ph: +39 49-893-4654, fax: +39 49-893-2897
StatSoft Pacific Pty Ltd. (Australia), ph: +613 9521 4833, fax: +613 9521 4288
StatSoft Japan (Tokyo, Japan), ph: +813 3667 1110, fax: +813 3668 3100
StatSoft Taiwan (Taipei, Taiwan, R.O.C.), ph: +886 2 5786587, fax: +886 2 5793179

The complete line of StatSoft products and training/consulting services are available from authorized representatives worldwide, including: Austria, Belgium, Brazil, Chile, Czech Republic, Denmark, Finland, Greece, Hungary, India, Korea, Malaysia, Mexico, The Netherlands, New Zealand, Norway, Portugal, Russia, South Africa, Spain, Sweden, Switzerland, Turkey. Please contact your nearest Statsoft office for the authorized representative nearest you. StatSoft, the StatSoft logo, STATISTICA, and Scrollsheet are trademarks of StatSoft, Inc.

Enter HotBYTEs No. 110 at http://www.byte.com/hotbytes/

Some network solutions are better than others.

Like the no-brainer, software-loaded, right-out-of-the-box, plug-it-in type.

When trying to keep a business up and running, finding the right solution can be the toughest job of all. Which is why Gateway 2000 Major Accounts, Inc. offers Custom Integration Services (CIS) to qualifying, large-volume purchasers. We'll work with you, and together, find the best custom solution for your business. Through this program, a wide range of hardware and software solutions can be built into your PCs. Including some products we don't normally sell.

Our CIS program increases your Value of Ownership by saving you the time and expense of breaking the box. Items like pre-loaded special applications and training software improve efficiency. For example, suppose your business uses a specific inventory control program or a certain type of backup storage device. We'll help you get that hardware or software built into your new GATEWAY™ systems, pre-test it to your specifications and ship it to your door. No third party installations. Just you and the plug.

With Gateway systems, you get high quality, fresh technology, stable platforms and manageability features. And with CIS, you also get the added benefit of having it all your way. This unique Gateway combination maximizes your Value of Ownership with increased benefits and reduced costs for the life cycle of your computers.

So call your Major Accounts sales representative or visit our Web site today. Together, we'll find a solution that's right for you.

MMX™ intel inside pentium® II PROCESSOR

NS-7000 300 Workgroup Class Server ▪ Intel® 300MHz Pentium® II Processor with 512K Cache (expandable to two processors) ▪ Error-Checking and Correcting Memory Subsystem with 64MB RAM ▪ Several RAID Upgrades Available ▪ 4GB Ultra Wide SCSI Hard Drive ▪ 12X SCSI CD-ROM Drive and 3.5" Diskette Drive ▪ 3Com® 10/100 Ethernet Adapter ▪ Seven-Bay Server Tower Case ▪ 300-Watt Power Supply ▪ 104+ Keyboard & Microsoft® IntelliMouse™ ▪ InforManager™ Server Management System with ActiveCPR™ Processor Protection **$2729** Business Lease †$96/mo.

E-3110 300 High Performance Network-Ready Desktop ▪ Intel 300MHz Pentium II Processor with 512K L2 Cache ▪ 64MB SDRAM ▪ EV700 .28 Screen Pitch 17" Monitor (15.9" viewable) ▪ AccelGraphics™ Permedia® 2 32-Bit AGP with 8MB SGRAM ▪ 8.4GB Ultra ATA Hard Drive ▪ 13/32X CD-ROM Drive and 3.5" Diskette Drive ▪ 3Com 10/100 Ethernet Adapter ▪ E-Series Mid-Tower Case ▪ 104+ Keyboard and MS® IntelliMouse ▪ MS Windows® 95 ▪ (DMI) 2.0 Compliant ▪ Intel LANDesk® Client Manager 3.1 ▪ Gateway Gold℠ Service and Support for E-Series PCs **$2349** Business Lease †$83/mo.

E-5000 300 Technical Workstation ▪ Intel 300MHz Pentium II Processor (expandable to two processors) ▪ 128MB ECC SDRAM ▪ Hitachi® 19" Monitor (18" viewable) ▪ 8MB Accel Graphics Permedia 2 AGP Graphics Card ▪ Seagate® 9GB 10,000 RPM Ultra Wide SCSI Hard Drive ▪ 13/32X SCSI CD-ROM Drive and 3.5" Diskette Drive ▪ SMC® 10/100 Network Card ▪ E-Series Workstation Tower Case ▪ 104+ Keyboard & MS IntelliMouse ▪ Intel LANDesk Client Manager 3.1 ▪ MS Windows NT®4.0 **$4099** Business Lease †$143/mo. CDRS-03 **32.42**

Gateway™ Solo™ 9100 Portable ▪ 14.1" XGA TFT Color Display (1024 x 768 resolution) ▪ Intel Pentium Processor with MMX™ Technology via Intel's Mobile Module (I.M.M.) ▪ SDRAM Expandable to 192MB ▪ 512K Cache ▪ 4MB EDO Video RAM (1280 x 1024 external) ▪ Up to 5GB Hard Drive ▪ Removable Combo 8X min/20X max CD-ROM & 3.5" Diskette Drives ▪ Premium Sound System w/16-Bit Wavetable Sound & Altec Lansing® Stereo Speakers ▪ 12-Cell Lithium Ion Battery & AC Pack ▪ Full 88-Key MS Windows 95 Keyboard ▪ Carrying Case ▪ NTSC/PAL Video Input & Output ▪ USB Ports & Zoomed Video ▪ 15-Pin MIDI/Game Port ▪ MS Windows 95 or MS Windows NT 4.0 ▪ MS Works 95 or MS Office 97, Small Business Edition plus Bookshelf® 96 ▪ LapLink® for Windows 95 & McAfee® VirusScan ▪ Gateway Gold Service and Support for Portable PCs **Prices starting at $3199** (Qty. 1) Business Lease †$112/mo.

GATEWAY2000®

"YOU'VE GOT A FRIEND IN THE BUSINESS"®

CALL 1-888-217-4941 www.gateway.com

Gateway 2000 Major Accounts, Inc.

©1998 Gateway 2000, Inc. All rights reserved. The Intel Inside Logo, Intel, LANDesk and Pentium are registered trademarks, and MMX is a trademark of Intel Corporation. Not all Gateway E-Series PCs and NS-Series Servers contain the Pentium II processor. The Gateway Solo PC does not contain the Pentium II processor. All brands and product names are trademarks or registered trademarks of their respective companies. Many Gateway products are custom engineered to Gateway specifications, which may vary from the retail versions of the software and/or hardware in functionality, performance, or compatibility. All prices and configurations are subject to change without notice or obligation. Prices do not include shipping, handling and any applicable taxes. Gateway 2000 Major Accounts, Inc. is a wholly owned subsidiary of Gateway 2000, Inc. †Leasing arranged by independent leasing companies to qualified commercial customers. Lease payments based on 36-month term. Lease terms subject to change without notice or obligation.

Deschutes: Pentium II Breakout

Intel's new processors, chip sets, and motherboards will establish the Pentium II as the standard in 1998 for low- and high-end PCs and servers.

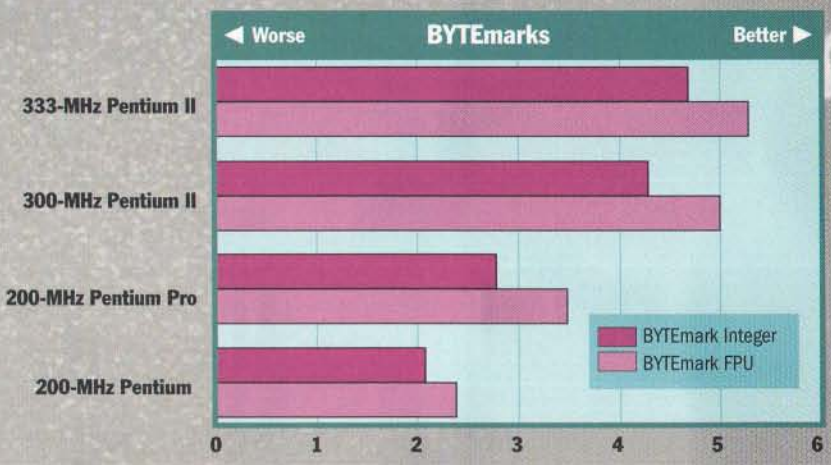
Intel has high hopes for its Deschutes-series Pentium II processors, which made their debut on January 26. If successful, Deschutes will be the turning point in Intel's campaign to make the Pentium II a mass-market product, phase out the Pentium, bring sixth-generation x86 technology to mobile systems, and render the Socket 7 interface obsolete.

Deschutes could also strengthen Intel's influence over the PC standard and, later this year, offer more diverse options for both high- and low-end PCs. All things considered, it's a lot to expect from a single product that essentially introduces no new features.

No new features? How can that be? If you're confused, join the club. No other Intel processor has been surrounded by as much market confusion as Deschutes.

Contrary to widespread belief, Deschutes implies nothing about the chip's core clock frequency, front-side bus speed, back-side bus speed, cache size, CPU interface, MMX, or system chip set. Deschutes is merely Intel's code name for a Pentium II processor manufactured on a 0.25-micron CMOS process. Nothing else distinguishes the Deschutes-series Pentium II from today's Klamath-series Pentium II.

Faster Pentium IIs Come Down the Chute*



* For more test results, see page 41.

Deschutes Pentium II Road Map for 1998

CPU	Interface	CMOS process	Core speeds	Front-side bus	Back-side (L2 cache) bus	L2 cache
Klamath	Slot 1	0.35 micron	233, 266, 300 MHz	66 MHz	116.5, 133, 150 MHz	512 KB
Deschutes	Slot 1	0.25 micron	333 MHz	66 MHz	166.5 MHz	512 KB
Deschutes	Mobile slot	0.25 micron	233, 266 MHz	66 MHz	116.5, 133 MHz	512 KB
Deschutes	Slot 1	0.25 micron	350, 400 MHz	100 MHz	175, 200 MHz	512 KB
Deschutes	Slot 2 (for servers)	0.25 micron	350, 400 MHz	100 MHz	350, 400 MHz	512 KB, 1 MB, 2 MB
Deschutes	Slot 1	0.25 micron	233, 266 MHz	66 MHz	Not used	None
Deschutes	Mobile slot	0.25 micron	300 MHz	66 MHz	150 MHz	512 KB
Deschutes	Slot 1	0.25 micron	>233 MHz	66 MHz	Core speed	128 KB, 256 KB on-chip
Deschutes	Slot 1	0.25 micron	450 MHz	100 MHz	225 MHz	512 KB
Deschutes	Slot 2 (for servers)	0.25 micron	450 MHz	100 MHz	450 MHz	512 KB, 1 MB, 2 MB

*The 440FX and 440LX may also support the low-cost Deschutes.

However, the smaller, more efficient process technology does mean Deschutes will run faster and cooler while consuming less power. That's why the first Deschutes attains a core frequency of 333 MHz—11 percent faster than Klamath's top speed of 300 MHz—with a die size of only 131 square millimeters, compared to 202 square millimeters for Klamath-series Pentium II chips. Power consumption is only 23.7 W at 333 MHz, compared to 43 W for a 300-MHz Klamath.

In all other respects, the initial implementation of Deschutes is identical to Klamath. Both CPUs come packaged in a Single Edge Contact (SEC) cartridge that fits Intel's proprietary Slot 1 interface. Both CPUs have the same P6 microarchitecture, including MMX and 32 KB of L1 cache memory.

Both have a 66-MHz front-side (CPU to system memory) bus. Both have an external 512-KB L2 cache made of industry-standard burst static RAMs (BSRAMs), which are contained in the SEC cartridge. Both processors drive the L2 cache at half the CPU core frequency. Both work with Intel's 440FX and 440LX chip sets, and others from third parties.

Both the Klamath and the initial Deschutes are limited by Intel's current CPU interface and system chip sets to a maximum of a two-way multiprocessing implementation. Later versions of Deschutes that target the sub-$1000 PC market will be more diverse (see below), and new system chip sets will let Deschutes go beyond two-way multiprocessing this year.

In the second quarter, Intel plans to roll out Deschutes processors at 233 and 266 MHz for mobile systems, followed by a 300-MHz mobile chip in the third quarter. All will dissipate 8 W or less. This will mark the debut of sixth-generation x86 technology in mobile PCs, allowing Intel to begin phasing out the Pentium for both mobile and desktop systems.

Late in the second quarter, Intel plans to ship Deschutes processors at 350 and 400 MHz. Those chips will still drive the back-side (L2 cache) bus at half the core frequency and will have 512 KB of L2 cache memory, but the front-side bus will cruise at 100 MHz. Accompanying them will be Intel's new 440BX system chip set, which supports the 100-MHz bus.

In June or July, Intel plans to deliver higher-end Deschutes chips for PC workstations and servers. Those CPUs will also have core frequencies of 350 and 400 MHz, along with the 100-MHz front-side bus. But they will drive the back-side bus at the full core speed. That will require Intel to divert precious foundry capacity to making superspeed BSRAM chips, because nobody else makes chips that fast in the quantities Intel needs.

L2 cache sizes for those high-end CPUs will be 512 KB, 1 MB, or 2 MB. To accommodate the larger caches, the CPUs will come in a larger SEC cartridge that fits Intel's new Slot 2 (for more information, see "Sorting Out the Slots," November 1997 BYTE, page 74). And Intel will introduce a high-end chip set, the 450NX, that supports glueless four-way multiprocessing, which should make it almost as easy to design a multiprocessor system as it is to design a uniprocessor one.

In the second half of the year, clock speeds will rise to 450 MHz for both the Slot 1 and Slot 2 Deschutes. Both will support the 100-MHz system bus and new chip sets.

Meanwhile, Intel is scrambling to respond to the sudden downward shift in PC prices, especially the hot sub-$1000 market. Around midyear, Intel plans to release a stripped-down Deschutes that doesn't have an L2 cache and comes in a cheaper cartridge.

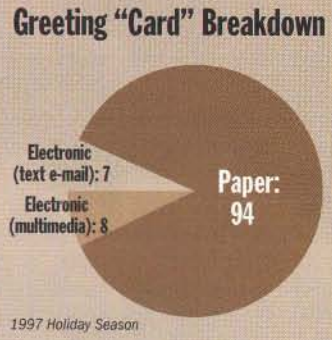
Later, Intel hopes to ship new versions of Deschutes that have L2 caches of 128 and 256 KB that are integrated on the same die as the CPU core. Thanks again to the smaller die size that the 0.25-micron process allows, it's more practical now for Intel to integrate the secondary cache. The on-chip L2 cache would run at the full core CPU frequency, delivering good performance at low prices. This parallels the plans of AMD

Power consumption	Chip set	
34.8–43 W	440FX, 440LX	'97
23.7 W	440FX, 440LX	Q1 '98
<8 W	440BX	Q2
Unknown	440BX	Q2
Unknown	450NX	Q2-Q3
Unknown	440LXR*	Q2-Q3
<8 W	440BX	Q3
Unknown	440LXR*	Q3-Q4
Unknown	440BX	Q3-Q4
Unknown	450NX	Q3-Q4

Geek Mystique

Geek Greetings, Part II

Technology appears to be creeping at an increasing rate into a time-honored custom of sending out greeting cards during the holiday season. In 1996, a BYTE editor received six holiday greetings electronically (e.g., an e-mail message that directed the recipient to an electronic holiday card available on the Web). In 1997, that number more than doubled, with a total of 15 greetings received electronically. And the electronic greetings are also getting more lively. Over half of all the electronic greetings received in 1997 were not static e-mail or Web pages, but cards that sang, moved across the PC screen, or decorated the computer's wallpaper.



Contents

Java Survey
26
Dual Analog Modems in Depth
32
GartnerGroup Report: Wary Customers Look Hard at ERP
34
Survive the Productivity Crunch
40

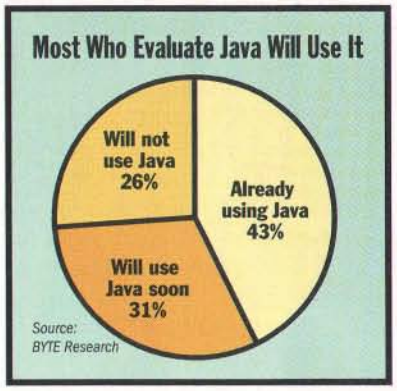
Survey Reveals Java Adoption Plans

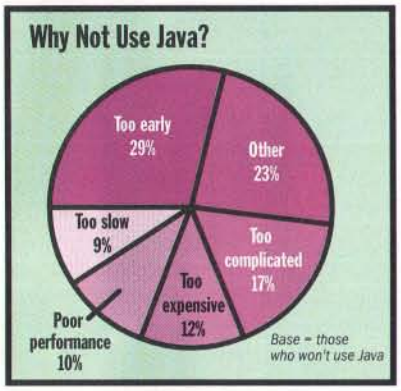
Highlights of our recent survey of Java users indicate that most respondents place a high value on Java's multiplatform capabilities, and more than half characterize the applets and applications they are developing as mission-critical. Additionally, most of them said Java execution speed is fast enough for their purposes.

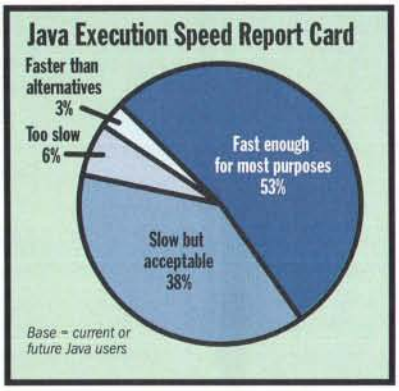
In BYTE Research's Java adoption study, 269 BYTE readers who had evaluated Java were surveyed. Application developers, senior corporate managers, and information technology (IT) managers made up the bulk of the survey pool, and the average size of the organization they worked for as measured by the number of employees was 620.

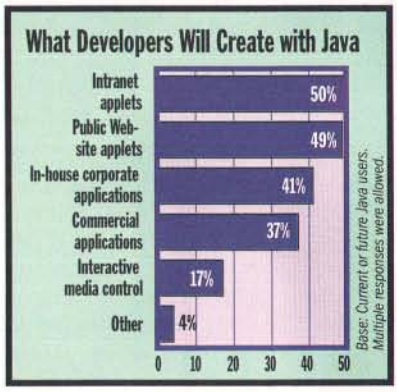
Most of the organizations that evaluated Java decided to use it: Almost 75 percent will either use it in the future or are already using it (see the chart "Most Who Evaluate Java Will Use It"). When asked why they wouldn't adopt Java, respondents' answers ranged from it was too early to poor performance and execution speed (see "Why Not Use Java?"). Almost one-quarter of the nonadopters' reasons fell into the Other category, such as Java was not applicable to their needs or people didn't have enough time to learn it.

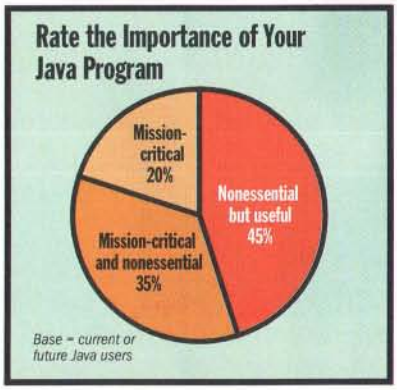
Those who are using or will use Java found its performance in terms of execution speed to be either fast enough or acceptable (see "Java Execution Speed Report Card"). Curiously, 6 percent of the Java adopters said Java was too slow, but they still plan to use it anyway.











Java users that were surveyed place a high value on the language's multiplatform capabilities: 80 percent said they are running or will run Java across multiple platforms. And a very popular use for Java is in database access. Almost eight out of 10 respondents (79 percent) say they will use Java for database access. Most plan to create applets for either intranets or public Web sites, or both (see

and Centaur Technology, who are also working on CPUs with integrated L2 caches.

Intel is likely to introduce a new chip set and a new type of motherboard to accompany the lower-priced processors. The chip set, known as the 440LXR, is rumored to be a low-end 440LX. It will probably allow fewer expansion slots (PCI, ISA, SIMM, and dual in-line memory module [DIMM]) and will have no support for multiprocessing. However, it may retain support for an Accelerated Graphics Port (AGP). The new motherboard, known as the Micro ATX, is smaller than a full-size ATX because it has fewer slots.

All these measures will lower Intel's costs a few dollars, but they'll also negate one of the technical advantages Intel claims for its proprietary CPU interfaces. By omitting or integrating the L2 cache in low-cost versions of Deschutes, Intel is eliminating the need for an external back-side bus—one of Intel's justifications for switching to slots. Either low-cost Deschutes could work just as well in Socket 7. In fact, a Socket 7 processor with an L2 cache might outperform a cacheless Pentium II.

Intel says it will still be easier to upgrade a CPU that fits a slot instead of a socket. But that depends on how Intel modifies the SEC cartridge to cut costs. If Intel discards the cartridge housing to reduce costs, the bare daughterboard would be as vulnerable to static electricity and other handling hazards as a conventional chip.

The advantage of proprietary slots, for Intel, is that they prevent competitors from selling CPUs that fit the same motherboards as Intel's. The sooner Intel can establish the Pentium II as the mainstream standard, the faster it can phase out Pentium-class CPUs and Socket 7 motherboards. Deschutes is a key step in that direction. **–Tom R. Halfhill**

www.byte.com

The Internet Appliance Toolkit (IAT) includes:

everything on the demo, plus
visual application builder
built-in internationalization
Watcom C/C++ compilers
drivers for hundreds of PC peripherals
embedded filesystems
demo apps with source files
scalable fonts
embedded OEM pricing
... and much more!

Build the Internet into smart phones, set-top boxes, photocopiers, kiosks, printers, PLCs ... anything!

Better yet, build it on time. The IAT™, used to create this demo, comes with everything you need, from rapid application development tools to Internet apps to source code. Build a custom browser in days, not months!

And talk about performance. With the IAT and QNX you can use low-cost x86 platforms to deliver incredible speed and reliability. Believe it!

Download your free 1.44M demo today!

www.qnx.com/iat

or call:

800 676-0566 (ext. 1062)

QNX®

The Leading Realtime OS for PCs

QNX Software Systems Ltd., 175 Terence Matthews Crescent, Kanata, Ontario, Canada K2M 1W8 Voice: 613 591-0931 Fax: 613 591-3579 **Europe:** 49 Dove Park, Chorleywood, Hertfordshire, WD3 5NY Voice: (44)(0)1923 284800 Fax: (44)(0)1923 285868

© QNX Software Systems Ltd. 1997. QNX is a registered trademark and IAT is a trademark of QNX Software Systems Ltd. All other trademarks and registered trademarks belong to their respective owners.

Enter HotBYTEs No. 108 at http ://www.byte.com/hotbytes/

Apparently there are those who do not subscribe to an all-Microsoft approach.

How can we be surprised? With all the mainframes, clients, application servers, databases and who knows what else you guys run in your enterprise, it would surprise us if any of you did.

That's why we're working on making all technologies (both new and old) work together in one interoperable computing environment. For example, Microsoft® Windows NT® and Microsoft Visual Studio™ development system enable developers to build solutions that integrate data from mainframe and UNIX server alike. It's just a first step in building solutions that incorporate all the pieces of your enterprise puzzle. Because we know that, in the end, the only approach you're going to subscribe to is your own.

To learn more go to www.microsoft.com/msdn

© 1998 Microsoft Corporation. All rights reserved. Microsoft, Visual Studio, *Where do you want to go today?* and Windows NT are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. Other product and company names mentioned herein may be the trademarks of their respective owners.

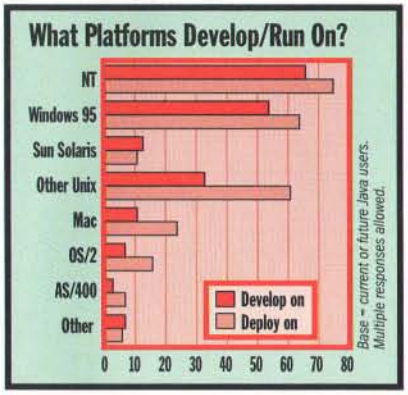
Microsoft®
Where do you want to go today?®

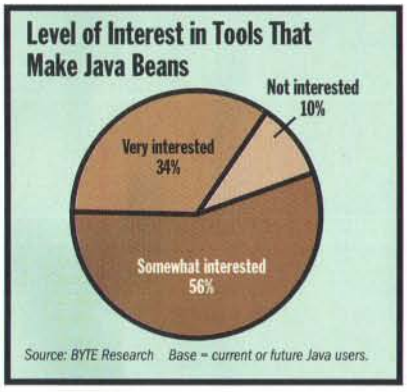
Microsoft®
BackOffice™

Microsoft®
VISUAL
Studio
Visual Basic®
Visual C++®
Visual InterDev™
Visual J++™
Visual FoxPro™

"What Developers Will Create with Java").

More than half of the sites surveyed will develop at least one application considered mission-critical (see "Rate the Importance of Your Java Program"). And Java is clearly a do-it-yourself platform for most respondents. Only 12 percent





are using Java programs developed outside their organization.

Despite the high interest in Java's write once, run anywhere capability, respondents are mostly developing or deploying on Windows 95 or NT (see "What Platforms Develop/Run On?"). But various flavors of Unix are also a popular platform for deploying and, to a lesser extent, developing Java programs.

When asked about Java tools, the responses were generally favorable: 28 percent were very satisfied, and 35 percent were somewhat satisfied. One percent said they were very dissatisfied with their tools, and 10 percent were somewhat dissatisfied. However, satisfaction does not equal complacency. Almost 60 percent say they are evaluating tool vendors all the time.

One thing Java users are interested in are tools that can produce client/server Java Beans (see "Level of Interest in Tools That Make Java Beans?"). Java Beans make up the component architecture for Java and let developers create reusable components. Half say some of their applications will use both client and server Java Beans.

And what about issues that tend to get prominent coverage in the mainstream press, such as the Sun/Microsoft legal conflict? That doesn't appear to be a big deal to BYTE subscribers. Of the current and future Java users, 82 percent said it would not affect their plans to use Java. And of those who said it has affected their plans to use Java, 39 percent said the only result of the lawsuit was a reevaluation of Java, but with no subsequent changes planned. About half (53 percent) of those saying the lawsuit would change their plans said it would slow adoption considerably; 8 percent said it had actually accelerated adoption considerably.

–Dave Andrews

Bug of the Month

Driver Wanted: Must Be Easy to Work With

BYTE editors recently tried to install a new Hewlett-Packard 5Si MX laser printer, only to discover that buggy driver software packaged with the printer made setup a perplexing, impossible task. When we installed the JetAdmin 2.33 software on a PC, the Windows 95 shell crashed whenever we tried to print. When printing from QuarkXPress on our Power Mac, the 5Si MX printed any page with a background as a solid black image and then crashed the system.

After consulting HP's technical-support people, we learned that our driver had a conflict with the Windows 95 shell. A source said that version 2.33 also had memory leaks and that "numerous defects were corrected between version 2.33 and the latest release, 2.50."

Discovering the cause of our Mac printing problems was a whole new kettle of toner. It turns out our HP driver crashes a Mac running QuarkXPress 3.32 if Quark's Balloon Help file is located in the QuarkXPress folder (where it ought to be). The conflict occurs between QuarkXPress 3.32 and Adobe PostScript drivers, and is documented only on the Adobe Web page. Once we moved the Balloon Help folder to the desktop, the problems ceased.

Our solution for printing from a PC? Simplify, simplify, simplify. Instead of installing all the software on our JetAdmin CD-ROM, we simply installed the Jet Direct protocol from a Windows 95 CD and pulled appropriate drivers from the HP Web site using Windows' Add New Printer function.

–Jason Krause

Send yours to jason.krause@byte.com

Future Watch

New Hard Drives Hold More Data

A recent breakthrough by IBM's Storage Systems Division presages hard drives by the year 2001 that store almost four times as much data as drives in desktop PCs today. IBM recently announced that its scientists have developed a hard drive that can store 11.6 Gb of data on a square inch of a disk space. IBM predicts you'll be able to buy products using this technology by 2001. Today's notebook hard drives store about 3.12 Gb per square inch, according to IBM officials, while desktops and servers hold a little less.

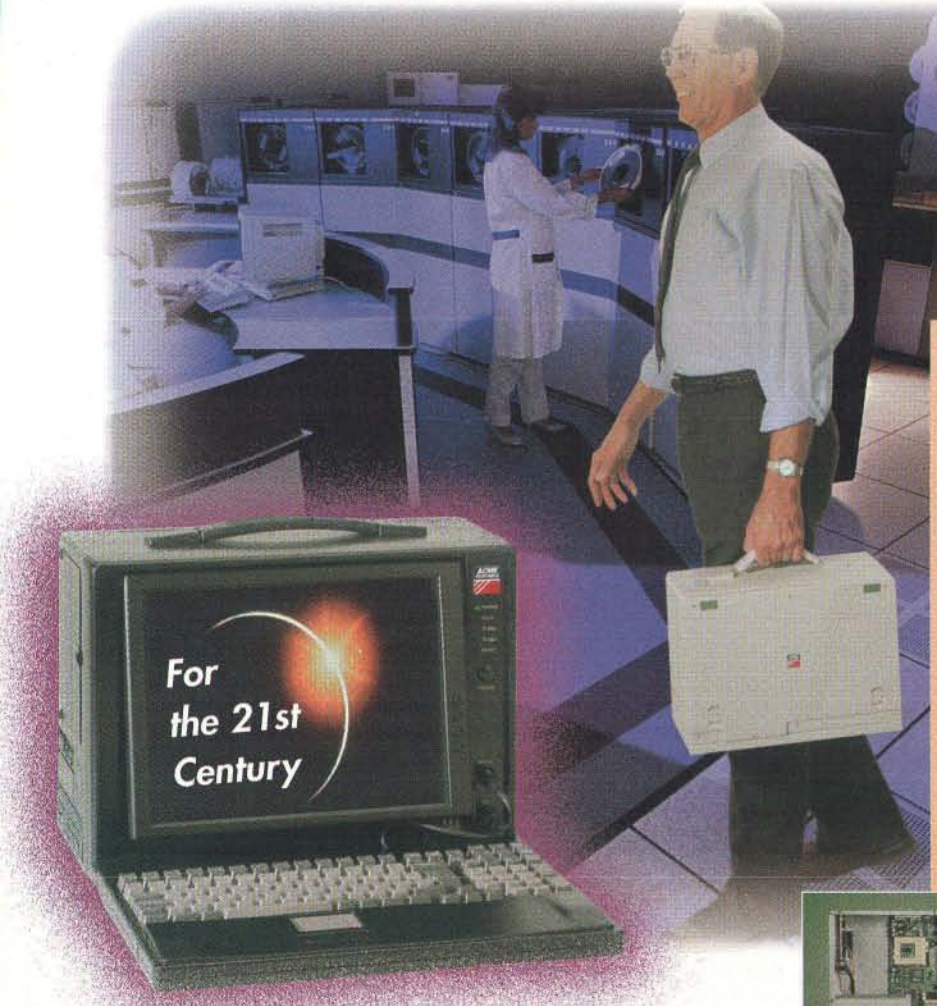
IBM used the combination of an advanced giant magneto-resistive head, a narrow-track thin-film inductive write head, ultra-low-noise cobalt-alloy magnetic medium, and extended partial response maximum likelihood (PRML) channel electronics to achieve the feat. In addition to more data per the same-size disk, the achievement could also lead to drives that hold the same amount of data as before but are smaller and consume less energy, useful for portable computers.

How much is in 11.6 Gb? Every square inch of disk space using this technology could hold more than 725,000 pages of double-spaced typewritten pages, which would make a stack taller than an 18-story building.

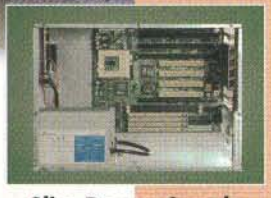
–Vishal Doshi

Now! All the Computing Power You Need... and All in One Hand!

Whatever the occupation and wherever the location, you will appreciate the **ACME LUNCHBOX COMPUTER** desktop computer **full capabilities** in a portable configuration. Imagine, large **TFT LCD** color panels with 4 MB video RAM to highlight every detail from the **Pentium II** processor for unmatched speed, and **flexibility** in the form of 8 card slots to customize the ultimate computing machine to your needs.



It took **ACME** to incorporate TFT LCD flat panels ranging from 10.2" to 13.3", 14.1", and 15.1" diagonally in a package only 15 3/4" x 11 1/2" x 8 1/4". Features include a 105 keyboard with built-in GlidePoint touch pad, language localization, high resolution (1024 X 768 max,) with full 262,000 colors, 3.5" floppy and 5.25" CD drives, super durable case and auto-sensing power supply.



Slim Power Supply

PS II Power Supply

Drive Bay & CD-ROM

CEBIT 98
World Business Center
Hannover, Germany
CA Pavilion
Hall 6, Stand: F05
Booth #1

PC IT'98
Sydney Convention
& Exhibition Center
Darling Harbour Sydney
US Pavilion
Booth # 735

FOSE 98
Washington Convention Center
Washington D.C.
Booth # 3027

ACME PORTABLE

ACME PORTABLE MACHINES, INC.
14140 Live Oak Ave., #D, Baldwin Park, CA 91706 U.S.A.
Tel: (626) 814-0516 • Fax: (626) 814-0323
http://www.acmeportable.com
E-mail: info@acmeportable.com

Enter HotBYTEs No. 126 at http ://www.byte.com/hotbytes/

Dual Modem Routers Double Your Bandwidth

The dual analog router is a new product that offers more than 100 Kbps of download speed over ordinary analog phone lines by bonding two 56-Kbps modems into a single high-speed connection. When downloading files, dual analog performance is about 75 percent as fast as a two-channel bonded ISDN connection (128 Kbps). Dual analog performance when uploading is slower (about 50 percent of the speed of ISDN).

The dual analog router can be found in several forms. Complete units include internal modems (e.g., the 3Com OfficeConnect Remote dual analog router, available for $745). Other units require external modems, such as the Ramp Networks WebRamp M3 (without modems, $439), and software solutions, such as the MidCore MidPoint Gateway.

The latest update of Windows NT 4.0, with the Service Pack 3 and the Routing and Remote Access update, has the ability to bond multiple modems but isn't as fully featured as the specialized products. Several more dual analog products (including offerings from Angia and Diamond) are expected soon.

Several important technological considerations need to be considered when choosing a dual analog router. One is channel-bonding implementation. The more technically elegant method is to use multilink PPP (MLPPP) to bond the modems into a single connection, so that the full bandwidth of both channels is available for any file download, whether it contains many small files or individual large files. This method (used by the 3Com OfficeConnect Remote product) lets bandwidth be most efficiently allocated. The only slight drawback is that it must be supported by the server at your ISP or main office. Fortunately, most current equipment supports MLPPP.

The second method of bonding channels (used by the WebRamp M3 and MidCore MidPoint Gateway) is to simply divide file requests among the modems. This method eliminates the need for MLPPP support and works well for Web pages consisting of several small files, but it performs poorly when transferring large files. Both methods require that your ISP or remote-access server allows multiple log-ins to the same account (one for each modem).

Another consideration is routing capability. If you plan to connect to multiple locations rather than just a single ISP (e.g., if you need to connect to the Internet and another office or if you want two ISPs for redundancy), be sure to choose a unit that supports multiple routes and destinations.

The dual analog router isn't simply a modem. You must configure and manage it just like any other router. A comprehensive configuration tool and configuration wizards help you to quickly (and correctly) configure your router. If the configuration tool is Web-based, you can manage your router from any convenient browser-based computer.

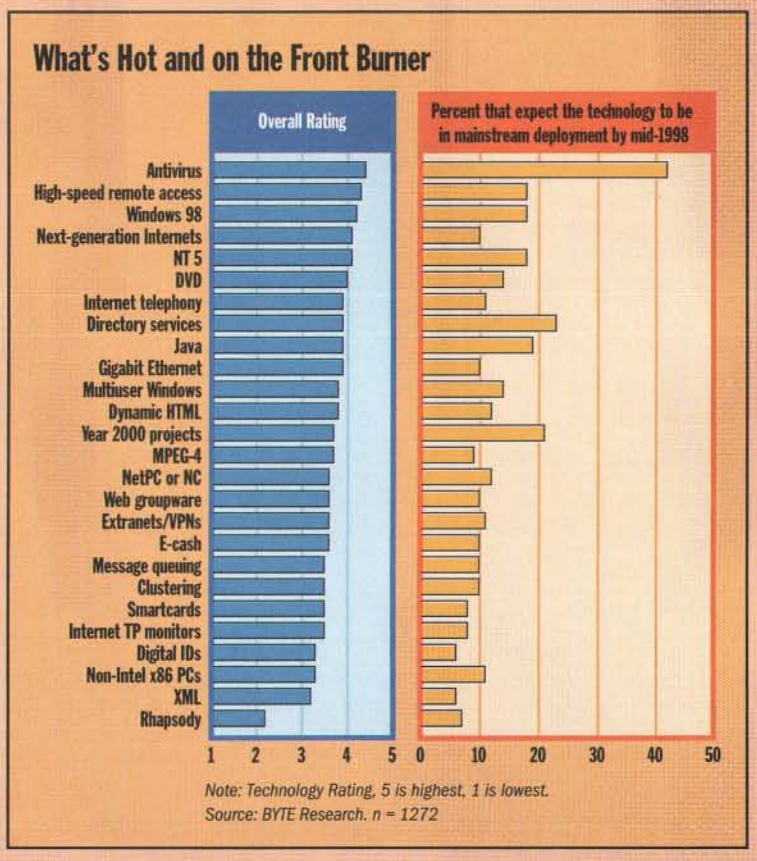
If you choose a router with internal modems, choose a unit (such as the one from 3Com) that you can flash-upgrade to comply with the new ITU 56-Kbps standard when it is finalized. Whether you choose a router with internal or external modems, you should ensure that your ISP or server supports the same 56-Kbps standard as your router.

continued

Survey

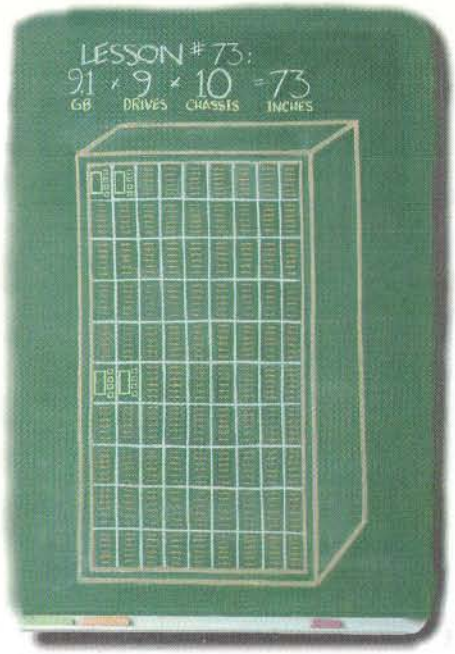
Top Technologies Adoption by Mid-1998

BYTE Research conducted a survey of Fall Comdex attendees to gauge how important certain technologies will be in 1998. Respondents (1272 total) were asked to rate on a scale of 1 to 5 (5 being the highest) a list of top technologies and to also estimate if they believed the same technologies would be in mainstream use by their organization by midyear. Clearly, virus detection and elimination is a hot area of concern, but other technologies such as directory services, Java, remote access, and Windows scored relatively high on the implementation meter.



Visit Artecon at Spring Internet World, Booth #7617

Artecon's New RAID Math



New RAIDvisor™ Software

Graduate to the Next Level.

9.1 X 9 X 10 = 73

Other entry-level RAID systems require you to anticipate your future storage needs due to confusing choices in controllers and enclosures. Graduating to the next level becomes difficult, if not impossible. LynxArray™ gives you true scalability by featuring the same controller and enclosure architecture whether you have 9 drives or 90 drives. You can start with a deskside tower using 9.1GB drives, increase your capacity ten times and move to a 73.5" rack with 100% investment protection.

From any entry point to a multi-terabyte RAID solution, each LynxArray component can be used toward your system's move to the next grade. Multiple hosts are supported, allowing for numerous configuration options. So you can really show that you've done your homework when you need to increase your storage capacity with Artecon's LynxArray.

No other RAID system on the market offers the scalability and investment protection of LynxArray - at any price.

For departmental to enterprise storage needs, LynxArray offers these top-of-the-class features:

- **Performance** - Our RAID controller surpasses the competition with I/Os of up to 4600 per second. Ultra-Wide, end-to-end SCSi achieves transfer rates of 40MB/s burst and 33MB/s sustained.
- **Hot-Swappable Controllers** - Hot-swap removable controllers allow for high availability and redundancy of your RAID system.
- **Package Density** - Configure up to 82GB of total capacity and still have room for hot-swappable failover controllers in only 7" (4u EIA).
- **JBOD/Tape Inline** - Backup your RAID system inline with DLT or hot-swap 8mm tape devices all within the same LynxArray chassis.

LynxArray subsystems are compatible with Sun, HP, SGI, IBM, Macintosh and PCs. Custom configurations and -48VDC telco models are also available.

So, if you are looking for a new and better way to solve your RAID storage problems, study up on Artecon's New RAID Math. **Check out our website or give us a call to see how it all adds up!**

1-800-USA-ARTE
www.artecon.com/raid

Artecon
Capturing The World In Storage™
A Member of the Nordic Group of Companies

RAB

6305 El Camino Real, Carlsbad, CA 92009
Phone 760-931-5500, FAX 760-931-5527 email: raidmath5@artecon.com
Nihon Artecon 81-03-5458-8260 ▲ Artecon B.V. 31-53-483-2208 ▲ Artecon France 33-1-6918-1850 ▲ Artecon U.K. 01344-636390

Artecon and the Artecon logo are registered trademarks of Artecon, Inc. LynxArray is a trademark of Artecon, Inc. All other trademarks are proprietary to their respective manufacturers.

GartnerGroup Report

ERP Customers to Vendors: Prove It First

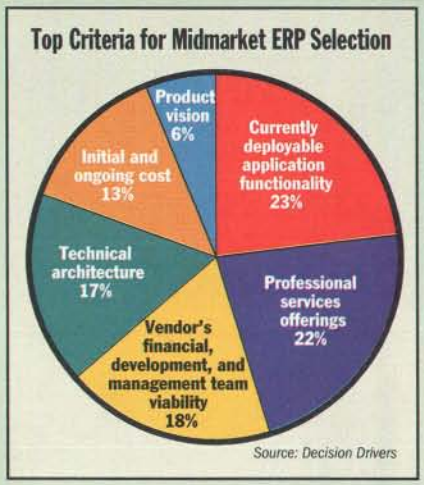
Prove it, or we won't purchase it. That's what customers are increasingly saying to vendors of enterprise resource planning (ERP) applications, and the reason is dissatisfaction with current product-selection procedures and their end results. A recent study conducted by Decision Drivers, Inc. (DDI), a GartnerGroup company specializing in information technology (IT) product selection, reveals severe deficiencies in the processes customers use when choosing their ERP package. According to the DDI survey, 64 percent of the ERP application-selection teams who used a traditional request for proposal (RFP) selection process reported a low level of confidence with that effort, the resulting decision, and the selected vendor's ability to deliver on promised functionality.

ERP evaluation teams working at midmarket organizations (i.e., ones with annual revenue between $250 million and $1 billion) are struggling to reconcile this confidence gap while making a vendor selection in an increasingly complex environment. A shrinking number of remaining tier 1–size prospects (those with more than $1 billion annual revenues), the availability of lower-cost computing platforms including Windows NT, and slowly decreasing implementation costs have driven ERP vendors that previously focused on tier 1 customers to look for new business in the midmarket segment. Companies unable to get high-end vendors to respond to an RFP one year ago, now find themselves courted by recently announced major initiatives from SAP, Baan, Oracle, and PeopleSoft.

Smaller deal sizes, equally complex requirements, and increased vendor hype have produced a tornado of activity in the midmarket. Traditional midmarket vendors are fighting back. Companies such as Symix, Data Works, and Glovia are creating partnerships, acquiring functionality, and developing vertical strategies to counter these new entrants.

Meanwhile, caught in a cross fire between these two sides, midmarket project teams have a much smaller margin of error than their counterparts working in bigger companies and are struggling to locate accurate vendor information, define mandatory requirements, and justify their selection to management. Application vendors have also been affected by this environment of uncertainty and must dedicate up to 40 percent more time per engagement from a presales consulting perspective. Vendors are spending precious additional weeks or months responding to increasingly demanding project teams, who are not willing to risk individual reputations or careers by relying on sophisticated, but standardized, vendor presentations that sell more sizzle than substance.

The result of all these factors has been a huge increase in the use of scripted demonstrations. Scripted demonstrations document and clearly communicate a comprehensive list of steps, processes, and compliance guidelines that a vendor must execute during a live presentation of its application. In this manner, the project team, rather than the vendor, determines the content of a live application demonstration and clearly sets expectations. The use of scripts represents a small but integral part of a structured selection methodology developed by DDI.



Demonstration scripts focus on organization-specific business processes, or technical requirements, and are developed by a selection team, in cooperation with functional or technical champions. Scripts must be specific enough, including the use of sample data, to custom-tailor a vendor's demonstration of its application capabilities. Scoring occurs during the vendor's response over a two- to seven-day presentation, on a pass-fail basis, and includes a value that correlates the suitability of the process used to the organization's requirements.

A standard scripted demonstration provides a list of steps that must be performed, includes the data that the transactions must be based on, and is typically designed along process-flow boundaries. Between 20 and 200 scripts are created in a typical selection, and their scope includes application-specific processes (e.g., the order-to-cash cycle) and technical requirements (e.g., security, disaster recovery, and backup strategies). Standard guidelines must also be developed and should include a requirement for a live presentation using the architecture being evaluated. This serves as proof of concept from a technical environment perspective and is most often focused on identifying and validating fledgling NT-based application capabilities and satisfying scalability concerns.

Jim Lebinski, *senior analyst for Decision Drivers, Inc., a GartnerGroup company. For more information, call 203-316-3631; fax: 203-316-6161; or james.lebinski@gartner.com.*

Software solutions, such as the capability built into Windows NT, require that you provide two or more 56-Kbps modems and a host PC. Hardware solutions without internal modems, such as the WebRamp M3, require that you provide two or more external modems. (Don't expect to use any old modems you have on hand—using anything less than current 56-Kbps devices will not give you the performance for which you are paying.) If you are using the router to dial into a main office, the main office remote-access server must support 56 Kbps—which means that it must have a digital (usually T1 or ISDN Basic Rate Interface [BRI]) connection.

If you need routing capabilities and a faster connection than 56 Kbps offers, but prefer not to make the jump to ISDN, a dual analog router may be just what you need. It will give you near-ISDN performance at moderate cost over ordinary phone lines. For best performance and flexibility, be sure to choose a router that uses MLPPP channel bonding, provides standard routing capabilities such as multiple route destinations, and offers a Web-based configuration tool, so you can manage it from any handy browser-equipped computer.

Keith Levkoff is a senior product analyst at Progressive Strategies (New York, NY), a technology assessment and market research firm.

your business is important to us. . .

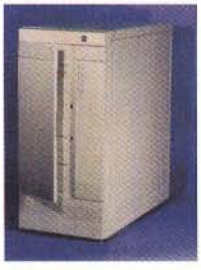
in more ways than one.

Monitors

OSD
Digital Controls
Exclusive 3 Year Warranty
Premium Monitors without Premium Price

Servers

RAID/RAIT Solutions
Tape Libraries
Custom Designed
Reliable, Scaleable
Fault Tolerant
Redundant Power Supplies & Cooling Fans



System Specials

Fully Assembled
Custom Configurations
Name Brand Components

Call Toll Free

800 642 3087

CTL

www.ctlcorp.com

Being aware of the ever changing needs of today's business, CTL builds systems to meet those needs. We have available a vast array of systems from desktop PC's to network servers.

Where appropriate CTL systems have passed system HCT testing and are compatible with Microsoft® NT. We are licensed by Digital Equipment Corporation to utilize their latest Alpha Powered® Technology.

Our monitor line is one of the finest available today. This is just another aspect of our commitment to you to provide highest quality at most reasonable pricing.

Bringing this latest technology to your business is our business. As CTL expands production capabilities, we will continue to be

linking you with the future . . . today

Call for Distribution & Reseller opportunities

Corporate Names and Trademarks are property of their respective companies

Enter HotBYTEs No. 122 at http ://www.byte.com/hotbytes/

Every Month, BYTE Reaches Over One Million Technology Decision Makers Around the World!

Did you know that the English-language version of BYTE is read by more than 500,000 technology decision-makers in over 100 countries? What's more, BYTE is read by another 500,000 technologists in 20 different local-language editions, making it one of the strongest global editorial brands in the world.

BYTE reaches over one million technical professionals who make real technology decisions every day – all around the world. Whether in the USA, Europe, the Middle East, Latin America, or Asia, these readers determine the appropriate technology strategies needed to solve corporate business problems, and they evaluate and recommend the purchase of the necessary products to do so.

For information on advertising in the English-language version of BYTE, contact Lori Silverstein at lorisf@mcgraw-hill.com.
For information on any of BYTE's International Partner publications, see the individual e-mail addresses listed on the adjoining page.

A Division of The McGraw-Hill Companies

BYTE International Partners

Argentina
lrodan@trade-venezuela.com
Circulation: 20,000

Brazil
mpetrilli@rever.com.br
Circulation: 60,000

Bulgaria
angel@topteam.bg
Circulation: 4,500

Chile
lrodan@trade-venezuela.com
Circulation: 10,000

China
bytechina@cbigroup.com
Circulation: 40,000

Colombia
lrodan@trade-venezuela.com
Circulation: 17,000

Greece
tsl@dolnet.gr
Circulation: 30,500

Hungary
tomkolossa@compuserve.com
Circulation: 10,000

Italy
c.giustozzi@mclink.it
Circulation: 40,000

Japan
ishii@nikkeibp.co.jp
Circulation: 80,000

Korea
dawor2@nuri.net
Circulation: 10,000

Mexico
nwbaker@mindspring.com
Circulation: 11,000

Middle East
khaldoon@arabia.com
Circulation: 20,000

Romania
rmaier@agora.ro
Circulation: 10,000

Spain
amenezo@mcediciones.es
Circulation: 40,000

Taiwan
claire_lin_at_twp@acer.com.tw
Circulation: 16,000

Thailand
wiroj@ar.co.th
Circulation: 30,000

Turkey
ac.ucisik@byte.com.tr
Circulation: 22,000

Venezuela
lrodan@trade-venezuela.com
Circulation: 18,000

Yugoslavia
vujadin@byte.co.yu
Circulation: 10,000

For more information on publishing BYTE in your country, contact:

Brad Browne, International Licensing Director
The McGraw-Hill Companies, Inc.
One Phoenix Mill Lane, Peterborough NH 03458
Tel: 603/924-2501 Fax: 603/924-7620 e-mail: bbrowne@mcgraw-hill.com

108 Years of National Geographic on CD-ROM

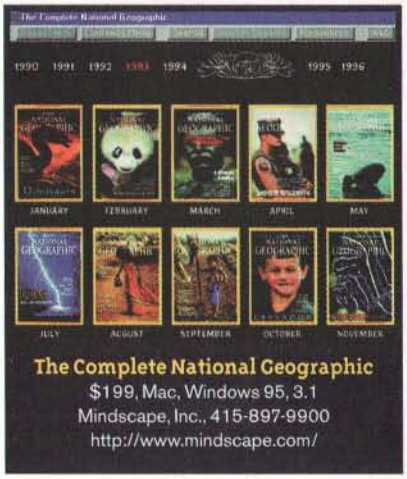
More than a century of National Geographic on CD doesn't disappoint.

When I was growing up, everyone knew someone with shelf upon shelf of aging, yellow-spined *National Geographic* magazines. Now, in a single 12-inch-wide box, I've got over a century's worth of them—every last article, photograph, and ad from 1245 issues, complete from the first issue in 1889 to the end of 1996. The only things not included on this set of 30 hybrid (Mac and Windows) CD-ROMs are the inserted supplemental maps.

This computer-publishing landmark is an extraordinary repository of information and images, and it's priced at a bargain-basement $199. This is thanks to sponsorship by Kodak. The sheer amount of content makes all those CD-ROM encyclopedias, however useful, seem puny by comparison.

To digitize the *Geographic*, Dataware Technologies needed five copies of each issue—6225 magazines, 2200 pounds worth, occupying 90 feet of shelf space. The initial images occupied over 300 GB, which had to be compressed to fit onto a reasonable number of CDs.

As a result, article text is much less crisp than I'd like. Viewed on a 14-inch monitor at 640 by 480 pixels, the type is readable but somewhat fuzzy. At 1024 pixels, it's smaller and thus looks a bit smoother. Some type, particularly in captions and graphics, is difficult (or occasionally impossible) to read. Photos are displayed in 8-, 16-, or 24-bit color, depending on your system. You can blow up the pages on-screen, which you'll need to do for ease of reading.



The Complete National Geographic
$199, Mac, Windows 95, 3.1
Mindscape, Inc., 415-897-9900
http://www.mindscape.com/

Extensive research or browsing can involve shuffling a lot of discs in and out. And almost 20 percent of each CD is occupied by the entire setup program and search index. This lets you start a session with any disc and run from the CD without copying 100 MB of search program and index to your local hard drive.

Because the pages are all graphic images, the text isn't indexed comprehensively, as we've come to expect on CD-ROM publications. But you can search on date, issue, subject, contributor, title, advertiser, photo, map, or keyword.

I printed out a number of pages with a high-resolution Lexmark 7200 color inkjet. The quality was decent, though not nearly as good as the original magazine pages.

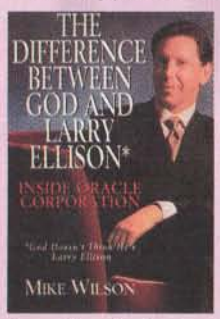
All in all, I'm much less bothered by the compromises needed to fit all this on CD than I am impressed and excited about this achievement. Bravo!

–Russell Kay

Book Reviews

The Inscrutable Larry Ellison

If you enjoy reading biographies about rich, obsessive egomaniacs who occasionally show they have a heart, you may want to pick up a copy of Mike Wilson's book, *The Difference Between God and Larry Ellison*: Inside Oracle Corporation (*God Doesn't Think He's Larry Ellison)*. Lawrence Joseph Ellison is the founder and driving force behind Oracle Software, the second-largest software company in the world.

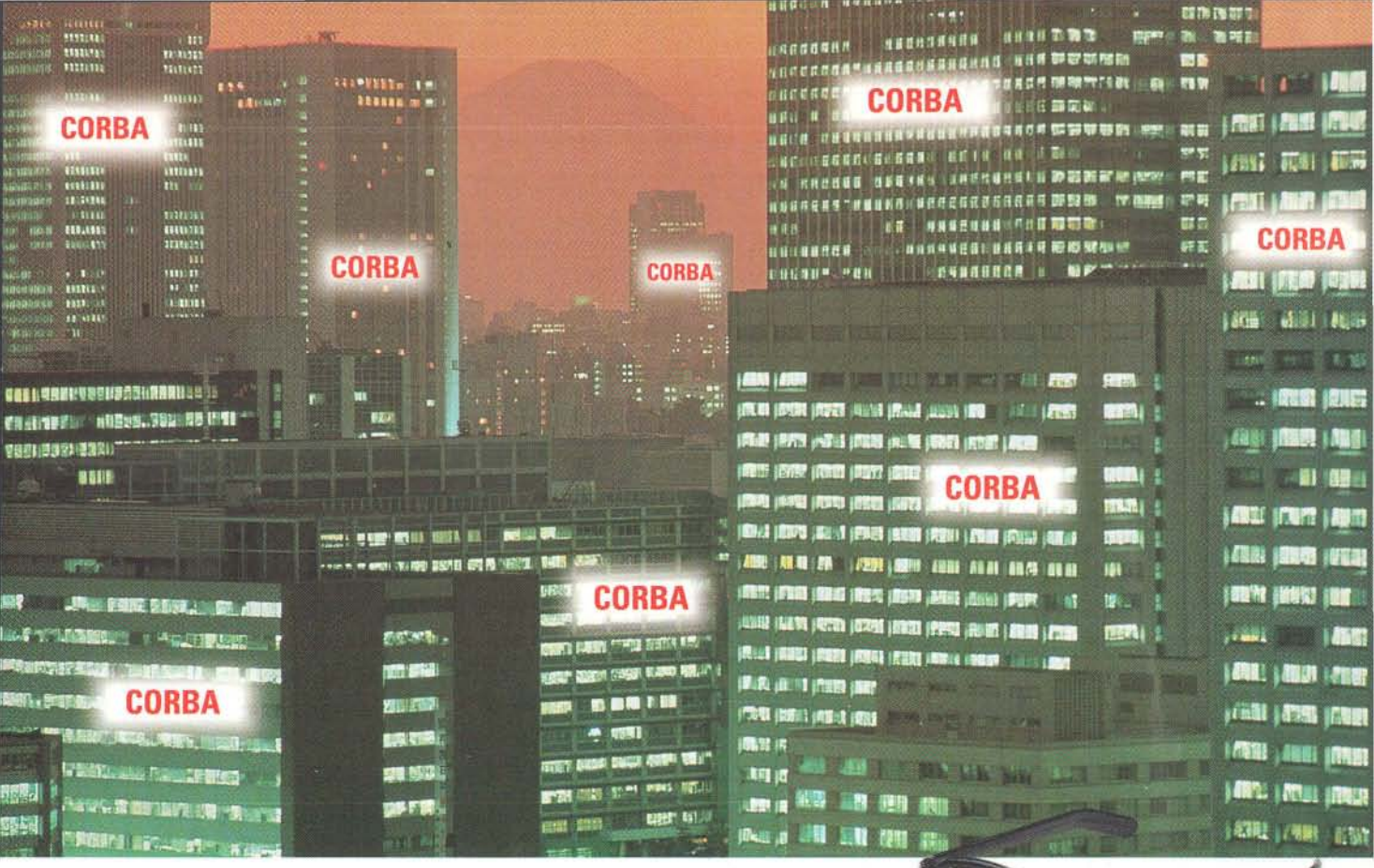


The early part of this book delves into the founding of the company and the development of relational-database software. It becomes clear that Ellison owes his fortune to an article published in June 1970 by an IBM researcher named Edgar H. Codd entitled "A Relational Model of Data for Large Shared Data Banks." Ellison and his partners were astute enough to build a working relational database based on SQL, a functional language that implemented Codd's theory, and the rest, as they say, is history.

Very quickly, the book shifts away from database technology and concentrates on Ellison's life both inside and outside of Oracle. We watch as he creates a corporation based on winning at any cost, even if that means using questionable, if not unscrupulous, business practices. For this book, Wilson interviewed hundreds of people—nearly everyone who ever knew or was close to Ellison. Unfortunately, you come away from this book with the sense that the truth about this man will never be known. Was Ellison a poor kid raised on the wrong side of the tracks in Chicago, or was he a middle-class child from a modest home? Did he receive a university degree, or was he simply a genius at inventing and reinventing his past? What role did Bill Gates play in fueling Ellison's fierce sense of competition? The book never says definitely. Readers of this well-documented exposé get a rare, if incomplete, glimpse behind the scenes of a powerful software corporation and a detailed portrait of its arrogant yet complex CEO—the inscrutable Larry Ellison.

Brad Browne *is the international licensing director for The McGraw-Hill Companies' Information Technology and Communications Group.*

The Difference Between God and Larry Ellison*: Inside Oracle Corporation (*God Doesn't Think He's Larry Ellison)
by Mike Wilson, William Morrow and Co., 1997, $25, ISBN 0-688-14925-1



CORBA

Middleware that's Everywhere.

CORBA is used today in mission-critical systems at industry leading companies.

It's used in one of the world's largest ATM networks and in the world's most advanced satellite communication system. It's used in industries as diverse as manufacturing, healthcare, telecommunications, finance, transportation, utilities and more.

Why is CORBA the middleware of choice for hundreds of leading companies?

Because CORBA is the only standard built using an open process that allows developers to deploy their mission critical applications on all major platforms—from PCs to mainframes and everything in the middle. Robust, scalable applications that can be deployed over the Internet—without additional programming. And CORBA gives users the flexibility to build or buy CORBA-conformant components, tools, products and services from hundreds of vendors.

The Object Management Group's CORBA is the middleware that's everywhere.

Over 800 industry leading companies are members of OMG, the world's largest software consortium.

To find out more about CORBA, email info@omg.org, visit www.omg.org or just call +1-508-820-4300.

OMG
OBJECT MANAGEMENT GROUP
Setting the Standards for Distributed Computing™

OMG®, Object Management®, are registered trademarks and CORBA™ and CORBA—Middleware that's Everywhere™ are trademarks of the Object Management Group.

Enter HotBYTEs No. 124 at http ://www.byte.com/hotbytes/

Blasts from the Past

5 Years ago in BYTE

You have mail! We predicted that e-mail would become a prevalent tool for business; but thanks to the Internet's popularity, it has become for many people a part of everyday life. Also covered: new applications from Lotus for OS/2, EO's Personal Communicator 440, and 600-dpi laser printers (priced from $2000 to $4595).

10 Years ago in BYTE

SQL was starting to gain acceptance in the PC database world, with vendors such as Oracle, Microrim, and Ansa (the developer of Paradox before Borland bought it) announcing support for the standard, although some supported it more than others.

15 Years ago in BYTE

A 5-MB hard drive that cost $3000 retail illustrates how far the storage industry has

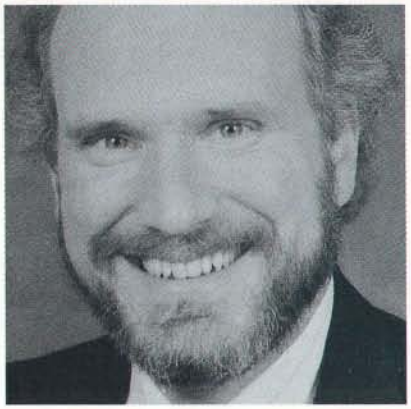
come in 15 years. In fact, this month's editorial noted that unless hard drives become less expensive, they won't become standard outside the office. Luckily for today's users, hard drive prices have fallen and will continue to plummet.

20 Years ago in BYTE

We reviewed two early personal computers, the Apple II and the Commodore PET, Model 2001. The Commodore system featured a version of BASIC developed by a small, but growing, company called Microsoft, which at the time was still located in Albuquerque, New Mexico.

How to Survive the Big Squeeze

Howard Rubin, computer science educator and editor of IT Metrics Strategies, on how to survive the productivity crunch.



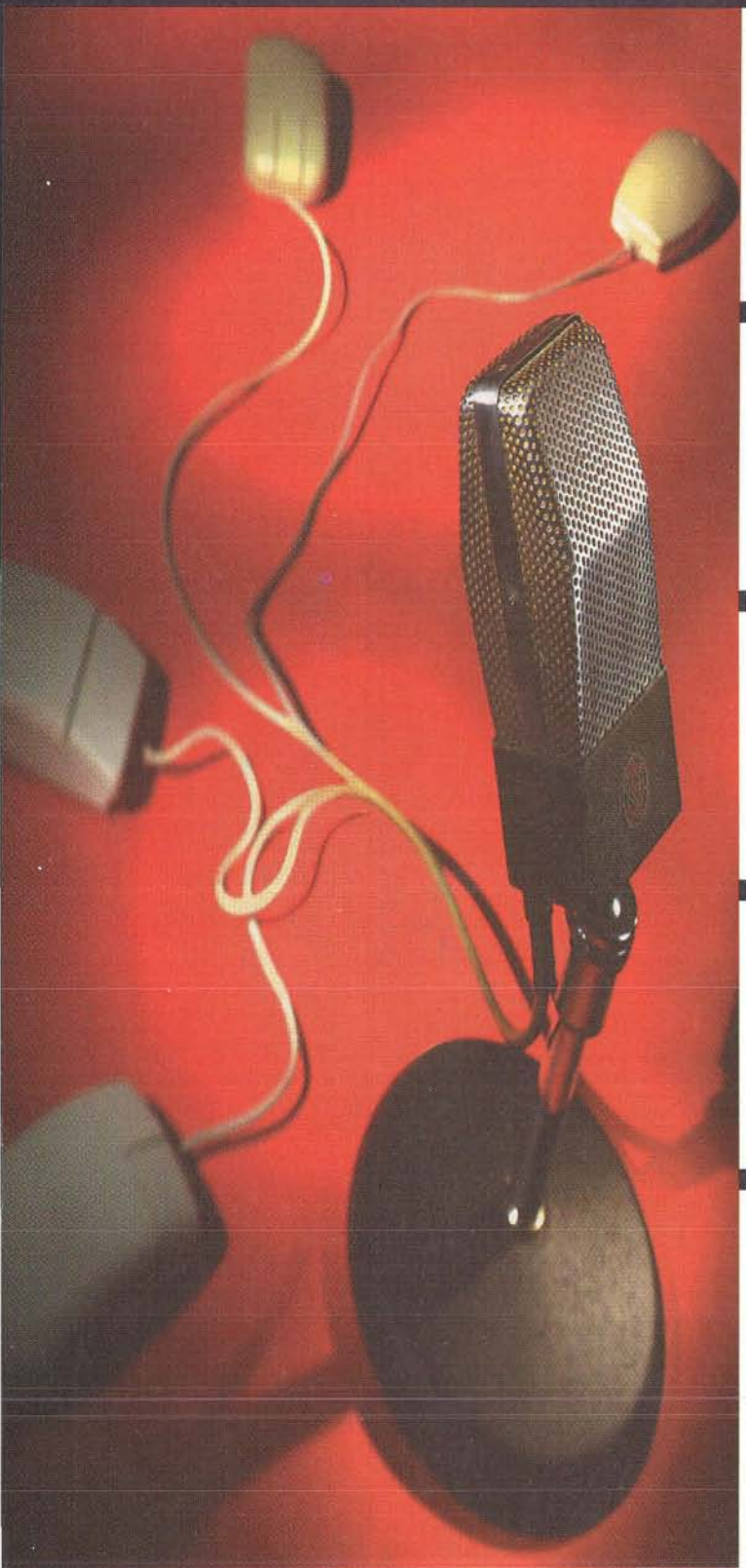
BYTE: *Recent studies have forecast an increasing demand for programmers. How bad will this be?*
Rubin: A number of pieces of research have indicated there's a shortfall of programmers in the U.S. and a large number of vacancies. To give you an idea, a study that was done and published by the Information Technology Association of America last year shows that at the time there were 200,000 unfilled jobs. Looking at the Department of Labor numbers and other people's numbers, there are somewhere between 1.2 and 2 million people in this country who would be classified in the software engineering field. That means there's about 10 percent fewer people than there are positions for them. That number looks like it will continue to rise. Business demand for information systems is growing by about 25 percent to 30 percent a year right now.

BYTE: *How can corporations deal with this shortage?*
Rubin: There a few things they can do. The crisis right now is not necessarily worldwide. There are core skill sets and competencies that are available around the world. Companies can get smarter and start adopting global sourcing strategies. You can get high-tech skills in Ireland, or India, so to overcome the crisis in the very short term, companies should not be looking at outsourcing, they should be looking at sourcing. That means moving work electronically around the world to the right price/performance point where the skills exist. Outsourcing usually means you hire a company and tell it to take over your mainframe or your application maintenance. A good example of sourcing is if you have some Java development that needs to be done, you send the work to another country. Sourcing really involves buying skill futures from companies, securing them in advance, and getting the rights to use those people. But sourcing is a short-term approach. More critically, companies need to focus on what their sources of labor are, because it looks like the offshore market will be saturated itself when it absorbs about 30 percent of U.S. demand.

BYTE: *What can companies do if that market gets saturated?*
Rubin: Companies need to start focusing on staff-retention strategies, because as salaries increase, people will be more tempted to jump. They also have to start looking at establishing their own farm league, their own supply of labor. They need to do that by looking within their organization to see if a change in skill mix is needed for the company and if other people need to be retrained. And they need to set up farm leagues in terms of alliances with universities to get first shot at new graduates, and partner with universities and technical institutions on curriculum to make sure when people do join, they hit the ground running. They also need to be focusing on the internal performance of their personnel and learning appropriate productivity strategies. Where can they use packages instead of writing things themselves? Where can they use other service providers and outsource business processes where they can be handled more efficiently? A whole range of strategies is needed, so that IT resources can be focused on the most strategic and important projects.

BYTE EXTRA

INTERNATIONAL



Simulation Software

Better integration with mainstream business applications.
Page 40IS 3

Embedded Applications

New design methods and processor architectures reduce cycles and costs. *Page 40IS 7*

Wireless Web TVs

More ways to access the Web are coming to Europe's homes.
Page 40IS 11

Speedy Wireless LANs

10-Mbps wireless LANs can carry complex audio and video files.
Page 40IS 15

Heitml Web Development

New tool enhances HTML.
Page 40IS 21

Generic OCXs & DLLs

Bar Code	
Bar Code Pro	£134
d-Barcode-32 Developers Kit	£146
Charts & Graphs	
Chart FX Enterprise 3.0 (16&32)	£263
First Impression 5.0	£135
Graphics Server 5.0	£210
Olectra Chart	£263
Comms	
CommTools/DLL	£215
Greenleaf CommLib 5.2 (DLL)	£235
Sax Comm Objects Pro	£369
Data Grids & Spreadsheets	
ActiveX Component Suite	£243
DataTable OCX	£135
Formula One 5.0	£135
Spread 2.5	£212
Database	
Classic Data Control for Btrieve Std	£175
CodeBase 6.3	£295
VBtrv Toolbox Controls 4.1	£209
Graphics	
Fastgraph for Windows	£189
InterAct	£275
TWAINWizard	£89
GUI	
AceToolbar	£75
ActiveListBar	£99
XRosyGUI	£233
Images	
ImageGear Std ActiveX 6.0	£495
ImageMan ActiveX Suite 5.0	£343
LEADTOOLS ActiveX16/32 Pro	£375
VectorFX	£244
Victor Image Proc for Win32	£390
Internet	
Distinct Visual Internet Toolkit 2.0	£249
dsSocket OCX 1.7	£70
Sax Webster OCX (32-bit)	£104
SocketTools	£186
Multi-Function	
OLETools	£163
Stamina	£150
WinX Component Library	£135
Reports	
Crystal Reports Pro 6.0	£220
Crystal Reports Standard 6.0	£83
Report FX Enterprise	£293
Spell Checkers	
Sentry Spell-Checker Engine	£235
VisualSpeller 2.1	£102
Sundry Components	
App-Link RADX Workstation	£139
Calendar Widgets	£99
Eval-O-Matic Suite	£188
Input Pro	£110
Schedule/OCX	£188
Text Editors	
ALLText HT/Pro OCX	£325
HighEdit Pro	£347
TX Text-Control Collection OCX	£267

JAVA

Jamba 1.1	£127
JBuilder Standard	£82
JBuilder Professional	£390
JBuilder Client/Server	£1681
JDesignerPro	£623
Parts for Java	£70
SuperCede Java	£99
SuperCede Java/ActiveX	£169
SuperCede Database	£455
Visual Café for Java Web Edition	£68
Visual Café for Java Professional	£197
Visual Café for Java Database	£348
Visual J++ Professional 1.1	£70
VisualAge for Java Professional	£66
VisualAge for Java Enterprise	£1250

DELPHI

Delphi 3 Standard	£81
Delphi 3 Professional	£382
Delphi 3 Client/Server	£1377
Abbrevia	£117
ABC for Delphi	£114
Apollo Standard 4.0	£148
Async Pro 2.1 for Delphi	£117
BoundsChecker 5.0 for Delphi	£330
Charting Tools for Win - Delphi	£174
Component Create	£162
DB Power 2.0	£148
Essentials	£44
Helping Hand 3.0	£104
HyperTERP/Pro	£320
ImageLib Win32&Win16	£116
InfoPower 3.0	£169
InnoView MultiLanguage Std 2	£144
List & Labels for Delphi 4.0	£295
Mobius Draw Kit	£99
Mobius FastSprites	£105
Orpheus 2.1 (32 & 16-bit)	£117
Raize Components	£150
SysTools	£98
Transform: Component Expert	£110
VB2D Standard	£174
VisualPROS 1.1	£125
WinG Sprite Kit	£99

EIFFEL

Graphical Eiffel Student (Win95)	£85
Graphical Eiffel Pro (Win16)	£465
TowerEiffel for Win32 Individual	£495
EiffelCase for Win32	£310

GREY MATTER

Prigg Meadow, Ashburton
Devon TQ13 7DF

Prices do not include VAT or other local taxes but do include delivery in mainland UK. Please check prices at time of order as ads are prepared some weeks before publication. This page lists some products – call us for a complete price list. ORDER BY PHONE WITH YOUR CREDIT CARD

(01364) 654100

FAX: (01364) 654200
www.GreyMatter.co.uk
maildesk@GreyMatter.co.uk

C & C++ FOR WINDOWS

Charts & Graphs	
3D++ Class Library	£290
GraphiC/NT 7.0	£360
Real-Time Graphics Tools	£315
Comms	
COMM-DRV/LIB 16.1	£124
Fax C++ SDK for Win16/95	£905
Compression	
Compression Plus	£202
Crusher! Win32	£225
Greenleaf ArchiveLib 3.0	£209
PKWare Data Comp Lib Win32	£225
Database	
DISAM96 for Win95	£715
HyperView++	£1002
ProtoGen+ Client/Server Win	£1370
Raima Engine + EADS 4.0	£740
Report Writer Visual Coder	£75
Velocis + EADS (Offer)	£250
Visual SQL	£958
Images - Bitmap	
Ad Oculos Win32	£385
Image SDK Plus for NT	£595
Maths & Stats	
IMSL C Numerical Lib w/Sub	£650
System Level	
Driver::Works (Win98 & WinNT)	£592
VToolsD (Win95)	£369
WinDK 2.5	£635
WinRT Developer's ToolKit	£242
WinSCSI-32	£129
Tools	
BoundsChecker C++Builder	£330
BoundsChecker Visual C++ 5.0	£462
C-Cover	£557
CC-Rider 6.0 (Win32)	£347
Exemplar Setup Toolkit Pro	£130
Thales (MS Basic to C/C++)	£2760

PROGRAMMER'S TOOLS

CASE Tools	
EasyCASE Pro	£694
EasyER 1.5	£485
EasyOBJECT 1.5	£485
Visible Analyst Corporate	£1833
Help Tools	
AnswerWorks	£388
Doc-to-Help 2.5(Win32)	£299
Documentation Studio	£499
DotHLP Pro	£89
Help Magician Pro 95	£207
HelpSite	£196
HyperText Suite	£292
NextHelp	£131
RoboHELP 5.0	£304
Visual Help Pro 3.1	£156
WinHelp Office 5.0	£426
Installers	
Eschalon Setup Desktop	£175
InstallSHIELD Express 2.0	£170
InstallShield5 Professional	£545
PC-Install (Win32 & Win16)	£150
Wise Installation System	£138
Wise Installation System Enterprise	£412
Macro Languages	
BasicScript VBX	£390
Cypress Enable (32- & 16-bit)	£741
Sax Basic Engine Pro	£369
Shells	
MKS Toolkit with preferred subs	£310
Thompson Toolkit	£138
Version Control	
MKS Source Integrity (with sub)	£465
PVCS Version Manager 5.3	£420
SMS 5.3	£445
TLIB 5.5 (Win32&16, DOS & OS/2)	£157
Visual SourceSafe 5.0	£399

VISUAL BASIC ADD-ONS

3d Graphics Tools 5 VB4 (32bit)	£143
ActiveThreed	£99
ActiveX Gallimaufry	£65
Applet Designer Enterprise	£381
ClassAction (VB4)	£105
ClassAssist	£175
CodeReview Pro	£276
Communications Library 3.5	£162
Crescent Internet ToolPak 3.01	£127
Designer Widgets 2.0	£99
Developer's Suite NetWare 5.0	£343
ERwin/Desktop for VB4	£395
FailSafe Pro	£276
Fax Plus 2.0	£202
Helping Hand 3.0	£104
Into Code (VB4)	£55
List Pro	£175
List & Labels for VB3/4 4.0	£295
PowerTCP Internet Toolkit	£486
QuickPak VB/J++	£160
Spyworks Pro Subscription 5.0	£199
True DBGrid Pro 5.0	£198
VB Assist 5	£130
VB2Java	£50
VBTools	£99

C++ COMPILERS

Borland C++ 5.0	£242
C++Builder Standard	£67
C++Builder Professional	£389
C++Builder Pro & BC++ Bundle	£198
C++Builder Client/Server	£1267
C++Builder C/S & BC++ Bundle	£890
Learn to Program w/C++Builder	£39
Power++ Developer 2.0	£308
Power++ Professional	£617
Power++ Enterprise	£1233
Salford C/C++ Dev Bundle	£295
Symantec C++ 7.5	£75
Visual C++ 5.0 Learning Edition	£72
Visual C++ 5.0 Professional	£377
Visual C++ 5.0 Enterprise	£919
VisualAge for C++ 3.5	£309
Watcom C/C++ 11.0	£206

DATABASE

CA-Visual Objects 2.0 Std	£82
Clarion for Windows Pro	£350
Omnis 7 Workgroup Starter	£399
Paradox (Win32) 7.0	£92
Personal Oracle8	£302
PowerBuilder Desktop 5.0	£175
Sybase SQL Anywhere 5.5	£177
Visual dBase Pro 7.0	£248
Visual FoxPro Professional 5.0	£403

News & Views

3D WebMaster

Create Virtual Worlds for Your Web Site

3D Webmaster provides a unique, intuitive approach to the creation of virtual worlds that contain animation, interaction and behaviours (such as gravity and collision detection). It includes an authoring tool for building worlds, a browser for testing them and a content library, where objects, textures, models & environments can be dropped into your evolving world.

Essential Lahey Fortran 90 3.0

Fortran 90 without the Legacy Features

Essential Lahey Fortran 90 is a Fortran compiler for students, engineers, and scientists who want to write programs using the modern features of Fortran 90, leaving out the redundant and inefficient language features from the past.

VB2Java

Convert Your VB Projects to Java

VB2Java is a full-fledged Visual Basic to Java translator, converting entire Visual Basic projects to Java applets or applications. It supports all the standard Visual Basic data types, including user-defined types and variant types.

App-Link

IPC Made Easy

App-Link is a highly intuitive and reliable mechanism for performing Inter-Process Communication (IPC) in Windows. Using App-Link, you can easily exchange data between processes running on a single computer or on multiple computers connected via a network.

PowerBASIC 3.5

The Best DOS BASIC Gets Even Better

PowerBASIC programmers can now allocate arrays in EMS memory, giving access to 16 MB of RAM for data. Other enhancements include native Console I/O, REDIM PRESERVE of array data, arrays in User-Defined Types, native ASCIIZ strings, indexed pointers, better code optimisation, and integer random numbers.

Visual SlickEdit 3.0

New Version of Programmer's Editor

Visual SlickEdit 3.0 now includes: Class Browser; Dynamic Tagging; Smart HTML Spell Checking; Nested Selective Display; Difference Editing; C/C++/Java Code Beautifier; Spell Checking; Colour Coding; Three Way Merge Edit; Syntax Expansion; SmartPaste; Macro Recorder & Hex Editor.

PC-Install 6.0

Create Installations Even More Easily

PC-Install 6.0 adds an industry-standard wizard run-time interface, more efficient builder interface, OCX registration, font installation, new commands like COPY and BACKUP, VB 5 support and complete context-sensitive on-line help.

DataGateway for Java

Access Data from Java

Borland's DataGateway provides Java developers a multi-tier, fast, and reliable database connectivity solution adhering to industry standard JDBC.

VISUAL BASIC 5

Visual Studio 97 includes the equivalent edition of Visual Basic 5 as well as Visual C++, J++, FoxPro & InterDev

Visual Basic Enterprise 5.0	£918
Visual Basic Professional 5.0	£378
Visual Basic Learning 5.0	£70
Visual Studio 97 Enterprise	£1125
Visual Studio 97 Professional	£765

BASIC LANGUAGE

PowerBASIC DLL Compiler 5.0	£135
XBasic Pro (Win32)	£525
VisualAge for Basic	£80

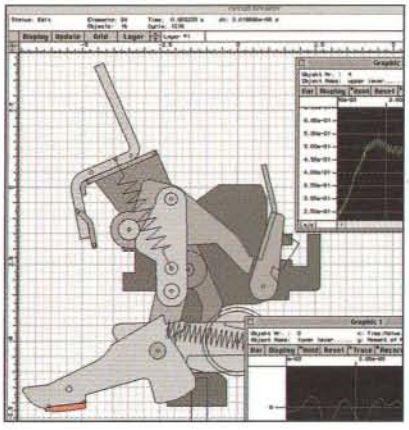
Better Simulation Software

Simulation software is easier to use, and you can integrate models with mainstream business applications over company networks.

Thanks to performance increases of PCs and object-oriented technology, better simulation software is entering the market this year. Several new packages from European and Israeli vendors help engineers bring their products to market faster.

The new software features refined virtual prototyping, optimization of business processes, open APIs, integration with enterprise software, and network access to models. "Simulation software used to be a stand-alone application," says Robert Fluttert, managing director of F&H Simulations in the Netherlands. "Corporations now want to use it in an operational environment."

While simulation technology has been a mainstream engineering and analysis tool for years, fully object-oriented simulation environments represent the next generation of simulation systems. Object-oriented simulation provides rapid modeling, hierarchical models, and an "engine" to drive entire enterprise-wide solutions.



Silux lets you interact with objects during a running simulation.

F&H's new Taylor Enterprise Dynamics (ED) product suite includes a discrete engine for flow modeling, simulation, visualization, and process control. With Taylor ED, developers can build models out of basic objects, called atoms. Their spatial coordinates and speed characterize atoms, and their superposition constitutes the dynamic behavior of a simulation model. They can be nested for complex object construction and can inherit properties from other atoms. Programmers can access atoms from any C++ development environment or use a scripting language to assemble atoms.

Dick Hillen, technical director of F&H, sees Taylor ED Developer version as a platform for a whole range of vertical-market solutions that may even integrate with real-time applications such as production control. The first vertical applications include the manufacturing and material-handling systems 4D Factory and 4D Motion. Later this year, F&H plans to release additional applications for scheduling and work-flow management applications.

continued

Next-Generation Simulation Packages

Product/vendor	Simulation technique	Typical applications	Network access to models	Availability	Price
Silux 1.0 http://www.silux.com +41 52 3660330	Continuous	Dynamics of large mechanical systems	No	Now	Starts at about $3400
Aesop Simple++ 5.0 http://www.aesop.de +49 711 138900	Discrete	Production-flow modeling, business-process optimization	Yes	April	Starts at about $8250
F&H Taylor ED 1.0 http://www.taylorii.com +31 30 2 311211	Discrete	Production-flow modeling, business-process optimization	Yes	Now; more modules later this year	Starts at $13,700
Emultek Rapid+ http://www.emultek.com +972 2 5870770	Digital mock-up	Virtual prototyping of embedded electronic products	Yes	Now	Starts at $20,000
Tecoplan Virtual Workshop 4.0 http://www.tecoplan.de +49 89 608 7620	Digital mock-up	Virtual prototyping in automotive and aerospace industries	Yes	May	Starts at about $3850

Aesop's Simple++ is another discrete simulation platform for modeling and visualizing industrial and business processes. It's based on an object-oriented programming (OOP) environment that lets developers visually choose physical objects such as transporters or buffers and objects such as triggers or generators to build models. It's possible to build complete simulations without writing any code, though a scripting language does help to build complex systems.

The next version, 5.0, slated for an April release, separates the simulation engine from the viewing mechanism, so that you can, for example, view simulations within your preferred CAD system. Another important feature of Simple++ 5.0 is an interface to enterprise software such as SAP R/3. These integration capabilities enable a manufacturing resource planning (MRP) system to directly activate a Simple++ function for data import or export. Says Constantin Schaible, marketing manager of Aesop, "The new concept aims at extending the value and lifetime of models across the complete production cycle."

In contrast to Taylor ED and Simple++, Silux AG's Silux is a continuous simulation system for mechanical systems including complex multibody mechanics. It is based on a finite difference algorithm that allows for the exact simulation of nonstationary mechanics such as crash behavior of bodies or the mechanical stress on a loaded robot arm.

Silux is impressively easy to use. "A Silux user works in a space that already 'knows' the complete physical behavior of an object. All you have to do is visually assemble the objects and define the external conditions," says Fritz Leibundgut, Silux AG's chief technology officer.

New simulation systems for virtual prototyping from companies such as Emultek and Tecoplan aim to reduce the development cycle of products. Emultek's Rapid+, for example, simulates the look and behavior of electronic devices, automatically generating user-interface (UI) specifications, documentation, and test scripts.

In addition, it generates C or C++ code for the UI logic that developers can directly embed in the real systems. With APIs to most microcontrollers and real-time OSes, automatic generation of code, test scripts, and documentation can shorten development time significantly. An early user at Bosch-Siemens in Germany reports that Rapid+ helped reduce development cycles from three years down to six months.

Tecoplan's digital mock-up software Virtual Workshop 4.0, expected to be released in a Windows NT and Unix version in May, features improvements in collocation and collision-detection facilities. It also includes a new space-mapping technology that allows for spatial queries in standard CAD databases. According to Thomas Koytek, managing director of Tecoplan, the new version also supports concurrent engineering in globally dispersed teams over extranets.

–Rainer Mauth

The European Information Technology Prize

The European Commission and the European Council of Applied Sciences and Engineering (Euro-CASE) recently announced the winners and runners-up of the prestigious European IT Prize. The awards are given to European and Israeli companies that have developed innovative technologies and products. The jury chose three grand prize winners and 22 runners-up. Many of the companies chosen have been featured in BYTE during the past year.

European IT Prize Winners

GRAND PRIZE

Applied Spectral Imaging
SpectraCube spectral-imaging system
http://www.spectral-imaging.com

Hyperwave
Hyperwave Information Management System for the Web
http://www.hyperwave.com

LCI-SmartPen
SmartPen digital ballpoint
http://www.lcigroup.com

RUNNERS-UP

Animation Science
Kinema/Way 3-D simulation environment
http://www.anisci.com

Beilstein Informationssysteme
CrossFire plus Reactions chemical database system
http://www.beilstein.com

Bull CP8
CC Cash Card smartcards
http://www.cp8.bull.net

Calluna Technology
CT520RM series of PC Card hard drives
http://www.calluna1.demon.co.uk

CoWare
CoWare development environment for ASICs (see feature story on page 40IS 7)
http://www.coware.com

Cygron Research and Development
DataScope decision-support system
http://www.tiszanet.hu/cygron

Digital Vision
BitPack MPEG-2 workstation
http://www.digitalvision.se

Elan Informatique
Dial & Play voice system
http://www.elan.fr

GemPlus
ImagineCard Web smartcards
http://www.gemplus.com/it_prize.htm

Graphisoft
ArchiCAD for TeamWork architectural CAD system
http://www.graphisoft.hu

Institute of Electronics and Computer Science
Dasp-Lab software radio-frequency analyzer
bilinsk@edzi.lza.lv

Intellart
Archibald voice-recognition system
http://homepage.iprolink.ch/~bioscan

Intracom
IoS Internet-via-satellite system
http://www.intranet.gr

Ivee
Spotfire Wizard visual data-mining system
http://www.cs.chalmers.se

Metaphor System
Metacast Ultra Weather Graphics Presentation System
http://www.metaphor.no

Philips Magnetic Heads and Modules
DigaMax digital tape recorder
http://www.km.philips.com/mhm/about/index_en.htm

PixTech
FE 532 flat-panel display for car navigation
csalvan@pixtech.mnet.fr

Plustech
PlusJack–Walking Forest Machine
http://www.plustech.fi

Recognita
Recognita Reader 3.0 multilingual OCR software
http://www.recognita.hu

Simone Research Group
Simone Control process-control system
simone@login.cz

Steinbeis Transferzentrum
Teleradiology System Chili teleconferencing system
http://MBI.DKFZ-Heidelberg.de/mbi/chili/

Target Compiler Technologies
Chess/Checkers DSP layout system
goossens@retarget.com

Compex MX1205 & MX1208 100 Mbps Fast Ethernet MicroHubs

Big Footprint...

(size 17)

Visit our website at www.cpx.com

Little Footprint!

(The MX1205 - only 240mm x 120mm x 44mm)

- **Ideal for SOHOs or small workgroups**
- **Internal power supply**
- **SnapLink for stacks up to 8 hubs; scaleable**
- **Neat and efficient - no cumbersome external cascading cables**
- **A company with over 10 years of networking expertise**

(The MX1208 measures only 340mm x 120mm x 44mm)

Choose Technology That's *Versatile* and Made for Your Environment.

You have critical space, cost performance and reliability requirements for your networking hardware. Be sure the products you buy are *versatile* and designed to efficiently meet those demands, and your environment.

Small but *Versatile* Compex 100MX Series MicroHubs!

The 5-port **MX1205** and 8-port **MX1208** Fast Ethernet MicroHubs were built by Compex with three goals in mind: **downsize the footprint, upsize the features and minimize the cost!**

USA OFFICE **COMPEX Inc.** Tel: (714) 630-7302 Fax: (714) 630-6521 • *SINGAPORE OFFICE* **COMPEX Systems** Tel: (65) 286 2086 Fax: (65) 280 9947 • *INDIA DISTRIBUTORS*
APCOM Computers Head Office: **Chennai** Tel: (044) 455 561 Fax: (044) 434 7051, **Ahmedabad** Tel/Fax: (079) 741 2308, **Bangalore** Tel: (080) 557 3211 Fax: (080) 556 2233, **Calcutta** Tel: (033) 475 9237 Fax: (033) 466 9004, **Mumbai** Tel: (022) 617 5198 Fax: (022) 618 3546, **New Delhi** Tel/Fax: (011) 648 1789, **Secunderabad** Tel/Fax: (040) 816 174
GODREJ Pacific Head Office: **Bombay** Tel: (022) 200 2841 49 Fax: (022) 207 2079, **Ahmedabad** Tel: (079) 583 0998 Fax: (079) 583 0336, **Bangalore** Tel: (080) 221 2419 Fax: (080) 663 2575, **Calcutta** Tel: (033) 357 2750 Fax: (033) 357 8271, **Hyderabad** Tel: (040) 204 056 Fax:(040) 203 587, **Madras** Tel: (044) 635 9667 Fax: (044) 625 7155, **New Delhi** Tel: (011) 682 4208 Fax: (011) 682 4206

COMPEX®

Networks That Work!

Enter HotBYTEs No. 143 at http ://www.byte.com/hotbytes/

Veccom's 2.4GHz PC / TV Wireless Link

Turn your existing PC into a dynamic home entertainment center !

The ideal collaboration tool in large conference rooms.

GN-711 is a wireless solution that accepts either a VGA or an A/V signal from multiple notebooks and desktop PCs for display on large screen TV's, video projectors and other remote display devices. High quality output comes in the form of composite video and high fidelity audio.

Unchains you from your desktop!

The GN-611 wireless solution comes with a wireless keyboard, giving you real freedom to enjoy computer games, surf the internet, or experience multimedia entertainment on a bigger remote screen, your TV, or a large display device anywhere in your home or office.

VECCOM

3 Tze Chiang 1 Road, Chungli Industrial Park, Tao Yuan Hsien, Taiwan, R. O. C.
Tel : 886-3-4515217 **Fax :** 886-3-4515216
E-mail : veccom@ms1.hinet.net **Website :** http://veccom.com.tw

IT'S VERY WELL MADE IN TAIWAN

CeBIT'98 HANNOVER
19. — 25. 03. 1998
Visit us in Hall 9, Stand C32/03

Enter HotBYTEs No. 152 at http://www.byte.com/hotbytes/

European ASIC Designs

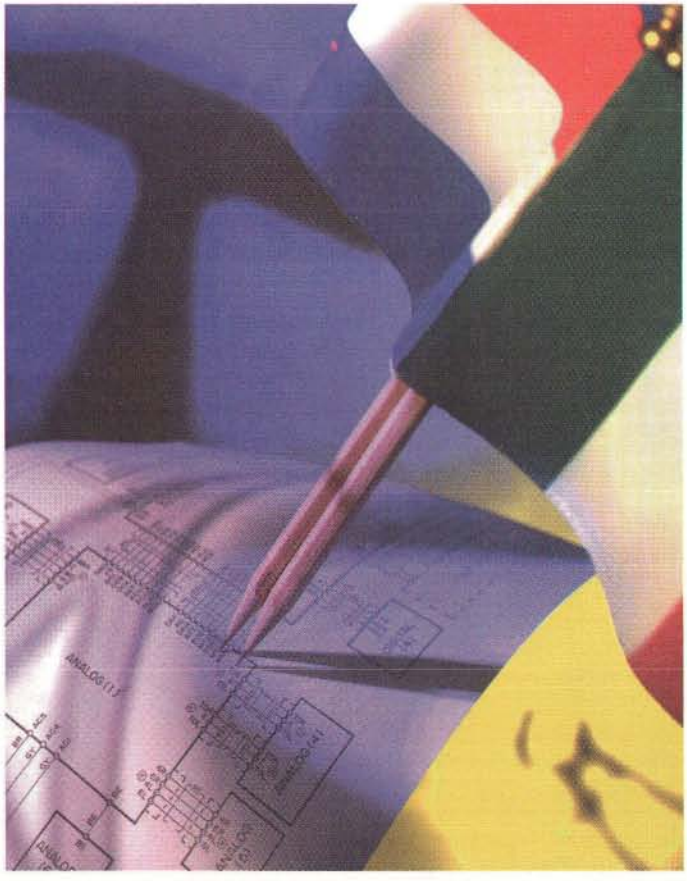
New design methods and processor architectures reduce development cycles and costs of embedded applications.

By Dick Pountain

Embeddable microprocessors have become an indispensable "raw material" for basically all industries. No car, washing machine, or television set is being built without intelligence inside.

European chip manufacturers such as Acorn, Philips, SGS-Thompson, and Siemens, as well as independent research centers, are at the leading edge in embedded processors. "That sector of the processor market is definitely where European firms can compete best," says Mike Muller, VP of product marketing at ARM.

Several of the European Commission's ESPRIT projects focus on development of embedded processors and the software to go with them. The current emphasis is on digital signal processors (DSPs), multimedia encoders, and new design methodologies for application-specific integrated circuits (ASICs).



PHOTOGRAPHY: EARL RIPLING © 1998

Hyperstone Combines RISC and DSP

One of the big challenges in microprocessor design for embedded applications is the combination of RISC and DSP functionality in the same processor core. Both functions are extremely important in devices such as smart phones, PDAs, set-top boxes, and laser printers. "Chips for these applications require both a RISC chip's excellent computing performance and a DSP's superior communications functions," says Dr. Matthias Steck, marketing director of the German chip designer Hyperstone Electronics.

A few approaches have tried to combine both designs on the same chip, but they tended to keep them as separate function units—communicating via an on-chip bus—and so resulted in very large die sizes. However, the Hyperstone processor (sponsored by the OMI's EURICO project) combines a 32-bit RISC engine and a DSP in the same core. The Hyperstone architecture lets both DSP and RISC units share key resources like cache, on-chip SRAM, I/O unit, and bus interface. This approach not only brings down costs by avoiding duplication of resources, it also makes the programmers' task much easier, as they no longer need to worry about synchronizing CPU and DSP operations—both are part of the same instruction set. Hyperstone's CPU and DSP cores also share the same address space, which further removes the need to transfer data between the units using DMA (as in conventional twin-chip solutions).

Both engines can work in parallel, executing, for example, a fast multiply-accumulate or a complex multiply DSP operation at the same time as a load/store or address calculation in the RISC engine. The DSP engine also shares the register set with the RISC engine, operating in parallel with the RISC's arithmetic logic unit, which can execute non-DSP instructions during the latency cycles of DSP instructions.

Applying RISC design principles like pipelining to the DSP engine means the DSP can run at clock speeds of over 100 MHz. Conventional stand-alone DSPs have mostly been stuck below 40 MHz. In return, the availability of complex DSP operations allows Hyperstone to use variable-length instructions that yield far better code density than pure RISC processors. Hyperstone instructions typically occupy half the memory of equivalent RISC code, which reduces the need for expensive memory.

Low-Power Chip

Two implementations of the Hyperstone architecture—the E1-32 and the E1-16—have been deployed in several applications. These versions differ only in their external bus architecture.

A Korean licensee, LG Semicon, now also manufactures and markets the E1-32 and uses it in its ASIC designs. LG's latest silicon

is an E1-32 fabricated in 0.6-micron CMOS, which offers performance of 66 MIPS at 66 MHz and 5 volts. Running at full speed, the 66-MHz E1-32 still consumes less than 1 watt of power, which means Hyperstone has crossed the economically important 200-MIPS/watt threshold for low-power chips. LG also manufactures the chip in a 50-MHz version at 3.3 V. Later this year, it will start producing 0.35-micron versions running at more than 100 MHz.

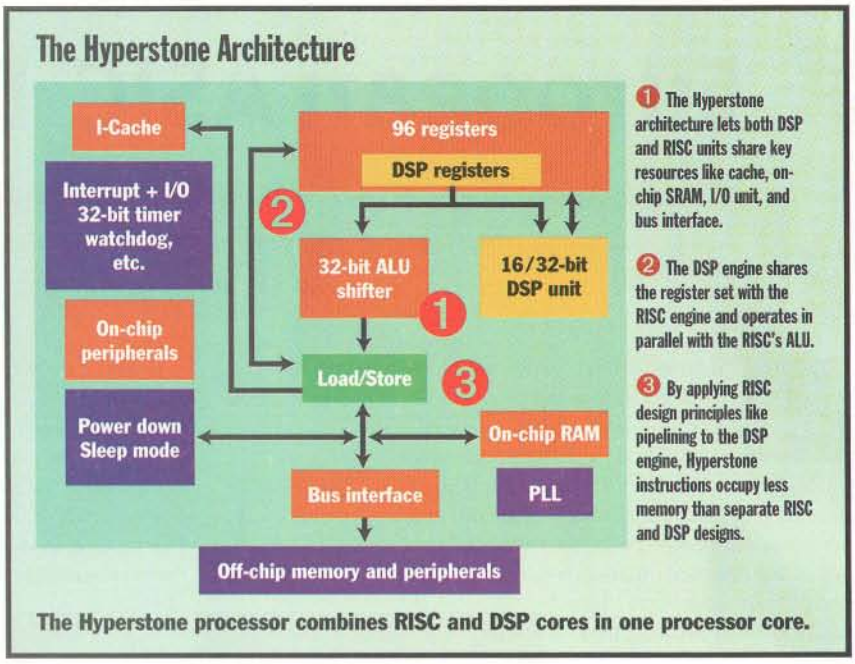
Performance of the processor family has almost doubled from the E1-32's 66 MIPS to 120 MIPS, accomplished with the latest version, the E1-32XP. The next generation of the Hyperstone architecture, E2, which is expected to be available in silicon late in 1998, will feature significant improvements in the DSP instruction set and have 8 KB of on-board RAM.

These continuous functional improvements go along with an increase in performance. Says Hyperstone's Steck, "In 18 months we will see another performance boost to 180 MIPS [in the E3 design]." The E3, slated for mid-1999, will feature better multimedia instructions and chip circuitry down to 0.25 microns.

EURICO Supports Hyperstone

The EURICO consortium is also working on a complete software environment for deploying Hyperstone, including real-time operating systems, C compilers, and other low-level development tools. The Belgian company Eonic Systems, for example, is porting its Virtuoso Nano OS kernel to Hyperstone, while Italy's Etnoteam is working on a full port of its Architecture-Neutral Distribution Format (ANDF) implementation to simplify Hyperstone's use in multiprocessor environments. (ANDF is a cross-platform binary software standard that allows applications to run on multiple platforms via on-the-fly translation.)

Other EURICO team members have developed several products based on the Hyperstone architecture. The German company SysKonnect, for example, designed a prototype of an Ethernet-to-ATM switch, and France's I&T COM built a low-cost cable modem. On the software side, Visual Tools, in Spain, is working on a software library of components for video and image compression. The Universität der Bundeswehr, in Hamburg, assists these projects by creating timing simulators to evaluate the performance of Hyperstone-based applications.



The Hyperstone processor combines RISC and DSP cores in one processor core.

Components Are Crucial

While sponsoring primary research certainly helps morale in the European semiconductor industry, it's only a start. To successfully turn processors such as Hyperstone into an industry platform, broad access to components that integrate with the platform is mandatory.

Development and design of components is the rationale behind ESPRIT's Europractice project. (The *practice* part of the name stands for PRomoting Access to Components, subsystems, and microsystems Technologies for Industrial Competitiveness in Europe.) Europractice complements OMI by encouraging joint research and industry projects to apply state-of-the-art chip technology in prospering markets. Europractice concentrates on ASIC design methodologies, multichip modules, and microsystems (complete devices like gas analyzers or radio transponders hosted on a single chip).

Europractice participating institutions include IMEC, in Leuven, Belgium; ETH

The Open Microprocessor Initiative

The European Commission's Open Microprocessor Initiative subtly changed direction during the last three years. The change of emphasis corresponds with shifts in the marketplace. In 1995, OMI encouraged European developers to adopt RISC architectures like ARM and SPARC instead of CISC architectures like x86. OMI also promoted building software bridges between RISC and CISC platforms. However, the RISC-versus-CISC debate has since fizzled out.

OMI now focuses on reusability and productivity improvements of embedded processors to reduce time to market and improve reliability. Its efforts are particularly targeted at the telecommunications, automotive, multimedia, and industrial process-control markets.

The initiative works by promoting cooperative projects between industrial and university research groups, and encouraging the exchange of intellectual property between semiconductor companies (for example, sharing macrocell libraries). On the commercial level, OMI runs an embedded systems industry association called OMI Management Office, which offers technical and marketing services to member companies.

The OMI Databook, which details the projects undertaken by its participants, now features 140 items, including six chip designs, four operating systems, over 40 software tools, and 29 major applications or products delivered as a result of collaborative development. Some of the most prestigious accomplishments are Chorus Systems' microkernel operating system, ARM's ARM6 and ARM7 processor cores, and SGS-Thomson's ST20 microprocessor.

Zurich; Fraunhofer Institute, in Stuttgart; the Rutherford Laboratory, in Oxford; and NMRC, in Cork, Ireland. Industrial partners include GEC-Marconi, SAGEM, Bosch, and Smith Engineering.

Belgium's IMEC, Europe's largest independent semiconductor research and development center, plays a significant role in Europractice's ASIC research. IMEC specializes in semiconductor processing and design methodologies. It owns 3300 square meters of clean-room space and has over $60 million in annual turnover from agreements and contracts with government agencies, aerospace firms, and semiconductor companies. Industrial clients include multinationals like TI, Philips, Intel, and Motorola. The institute's projects span the whole range of semiconductor research: basic work on submicron fabrication technologies, optoelectronics, materials science, memory technologies, solar cells, communications products, and futuristic research on quantum devices and epitaxial silicon heterostructures.

It also has considerable experience in chip manufacturing. IMEC's new CAST service, for example, provides universities and industrial firms with small quantities of prototype chips.

Codesigning ASICs

One of IMEC's most interesting current projects investigates new design methodologies for ASICs. Today, ASICs are usually built from off-the-shelf macro-cell circuits such as RISC or DSP cores and customized circuitry to meet the needs of specific applications. This reduces design and debugging time to a certain extent because the core has already been tested in the field.

However, as the industry is now passing beyond 0.35-micron process geometries, it's possible to build whole systems on a single chip, with one or more major functional cores, RAM, ROM, and custom processing circuitry. The aim of IMEC's newly developed design methodology is to devote custom hardware to the hardest parts of the job, while processing the less critical parts in software running on a RISC or DSP core.

A team of application experts, hardware engineers, and software developers usually conceives the design of such chips and the corresponding firmware. IMEC, therefore, developed a suite of tools that supports the cooperative and simultaneous design—codesign—of an embedded system's hardware and software. "Our tools support interactive system design and automate the most error-prone design steps," says IMEC's Ivo Bolsens.

Codesign involves first creating a specification for the embedded application, using an abstract notation in which processes communicate by remote procedure calls. The next step is to partition

A Sampling of New DSP Designs

Recent conferences have exhibited a range of new digital signal processor architectures, with innovations such as highly parallel processing in the BOPS ManArray, dramatic FP performance improvements in new TI processors, and CPU+DSP combinations, like the StrongARM SA-1500, for next-generation multimedia applications.

ManArray: DSP Supercomputing

The team that developed the M-FAST DSP at IBM formed Hot Chips & Salsas—now known as BOPS, Inc.—and recently announced its first product architecture, an array computing topology known as ManArray.

ManArray is based on a manifold array of integer/FP DSP processing elements (PEs), each capable of up to 3.2 billion operations per second (BOPS) at 100 MHz. The 3.2-BOPS figure was calculated based on a maximum execution rate on 8-bit single instruction/multiple data (SIMD) integer operations. Four PEs, organized as a 2x2 matrix in the basic ManArray building block, are controlled by a single sequence processor (SP); besides including all PE features, the SP also provides address and control functions. Each PE executes compact 32-bit encapsulated VLIW (EVLIW) instructions. This allows up to five 32-bit operations to be sent from the SPs to the PEs for parallel execution in every cycle by a single 32-bit instruction. EVLIW instructions provide operations on packed data types, as well as loads and stores from local PE memory. Every PE and SP can execute up to five instructions (multiply, add, load, store, data select) in a single cycle.

The flexibility brought by ManArray will be interesting for a number of DSP as well as general-purpose applications. BOPS has decided to offer licensing of the ManArray architecture and instruction set to companies involved in 3-D graphics, video, communications, and process control. The basic 2x2 core chip, known as Kittyhawk, is expected in mid-1998. According to BOPS, it should be the first programmable MPEG-2 codec implementation at prices comparable to fixed-function devices from vendors such as C-Cube.

TI Goes FP Parallel

Texas Instruments has used its expertise from the 1600-MIPS TMS 320C62x fixed-point DSP family to develop its superset TMS 320C67x generation of floating-point 32-bit DSPs. The new family starts at the 1-GFLOPS performance level, a speed enviable for inexpensive DSP chips, and is expected to grow to 3 GFLOPS in the next two years, according to TI. The first samples are expected in the second half of '98.

StrongARM with a DSP Twist

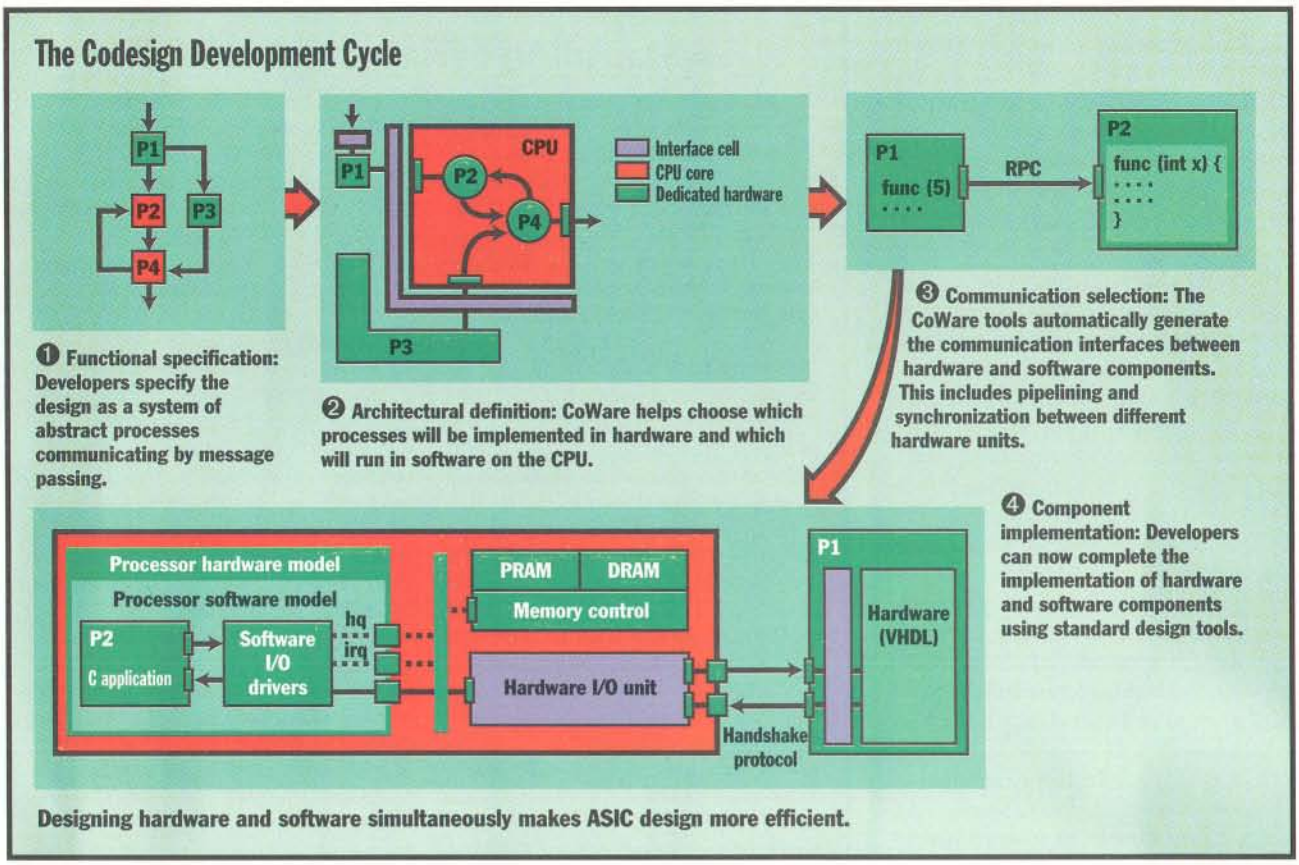
While it may be already transferred to Intel by the time you read this, Digital's StrongARM processor family remains the top contender for network computers and high-powered palmtops with functions such as voice and handwriting recognition. The new 300-MHz SA-1500, combining a fast StrongARM CPU and a dedicated Attached Media Processor (AMP) DSP, could perhaps provide the best of both worlds.

While the central execution unit on the chip is basically the standard StrongARM CPU running at a higher speed than before and with large 2 × 16-KB instruction and data caches, the AMP can do dual tasks. First of all, it can work either as a tightly coupled coprocessor, where either one ARM or one AMP instruction can be launched every cycle, or it can run in a parallel execution mode, where it operates in parallel with ARM. In that mode, AMP instructions are fetched from a 4-KB 64-bit writable control store.

AMP has 64 36-bit registers with support for both integer and FP data types. It provides the usual set of DSP instructions with single-cycle throughput. Using FP multiply-accumulate instructions, the maximum FP throughput for the SA-1500 is 600 MFLOPS. Looking at SIMD integer operations, the maximum throughput for the SA-1500 with both ARM and AMP operating in parallel is a respectable 3.6 BOPS.

To ensure sustained high performance, the SA-1500 has a 64-bit 100-MHz SDRAM main memory bus with 800-MBps bandwidth, as well as a separate 50-MHz general I/O bus with a 15-channel DMA controller. Combined with an I20-compliant PCI-PCI bridge, such as the DEC 21554, this chip could form the base of a high-performance combined I/O and multimedia coprocessor, able to accelerate I/O tasks such as XOR-data generation for RAID arrays and multimedia tasks such as real-time DVD playback.

– Nebojsa Novakovic



this specification by assigning the more critical processes to custom hardware blocks and the others to software running on CPU or DSP cores. Developers then go on describing the hardware blocks using their usual circuit design tools and generating the software processes in C or C++ code.

At this point IMEC's automated codesign tools, called CoWare, jump in and automatically generate all interfaces that will bind these hardware blocks together. CoWare generates interface cells, handshake protocols, and processor I/O blocks while at the same time building the corresponding I/O drivers and real-time kernel functions to schedule the processes.

IMEC's recent spin-off company, also called CoWare, now further develops and markets the CoWare tool suite. The current product includes an interface generator, called Symphony; a retargetable code generator, called Chess, that simplifies software design; a retargetable simulator (Checker); a specifications converter (Matisse); and a decision-support tool for designers (Atomium).

Chess can compile the same C source program into machine code for a variety of different RISC cores, based on parameterized templates. Checkers assists in designing custom DSP cores by simulating their instruction sets at thousands of instructions per second. Matisse, still in prototype stage, turns a high-level specification of a whole system into a CoWare description. From this description Symphony can then generate the corresponding interfaces.

WHERE TO FIND

CoWare
Leuven, Belgium
+32 16 298 440
fax: +32 16 298 319
marketing@CoWare.com
http://www.coware.be

Eonic Systems
Aarschot, Belgium
+32 16 62 15 85
fax: +32 16 62 15 84
Mailinfo@eonic.com
http://www.eonics.com

Etnoteam
Milan, Italy
+39 2 26162-1
fax: +39 2 2611 0755
http://www.etnoteam.it

Hyperstone Electronics
Konstanz, Germany
+49 7531 98030
fax: +49 7531 51725
info@hyperstone.de
http://www.hyperstone.com

IMEC
Leuven, Belgium
+32 16 28 12 11
fax: +32 16 22 94 00
http://www.imec.be

I & T COM
Metz, France
+33 3 87 75 57 81
fax: +33 3 87 75 84 40

Syskonnect
Ettlingen, Germany
+49 7243 502 526
fax: +49 7243 502 593
sales@syskonnect.de
http://www.syskonnect.de

Visual Tools
Madrid, Spain
+34 1 535 2642
fax: +34 1 535 3695
info@vtools.es

Trade-Offs

When designing a DSP-based ASIC, many choices are possible between buffering data in memory or computing results on the fly and sending them over the circuitry. The choices adopted will affect power consumption as well as size and complexity of the final design. At present, most decisions on where to store and where to compute and send data is based on the designer's intuition, because usually there isn't enough time to try out all alternatives. Atomium, on the other hand, lets the designer experiment with different trade-offs between storage and communication channels to optimize physical properties of a chip.

Tools like the CoWare suite and the art of codesigning ASICs could become very popular among semiconductor vendors. The reason is simple: Short design cycles and low power consumption are crucial features in all embedded applications. B

Dick Pountain is a longtime contributing BYTE editor who lives in London. You can reach him at **dickp@cix.compulink.co.uk.**

www.byte.com

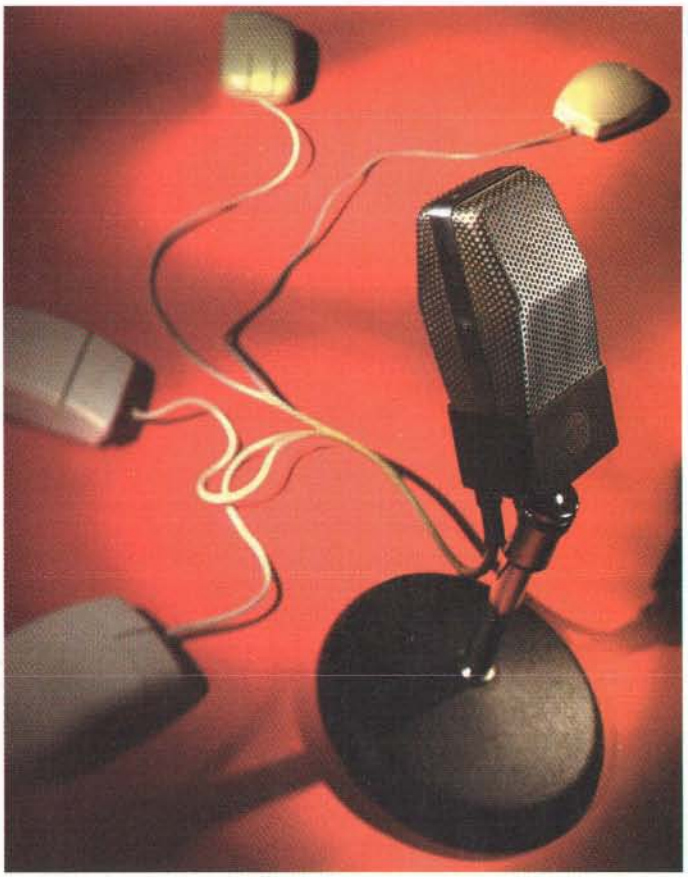
Webcasting Over the Air

More ways to access the Web are coming to Europe's homes.

By Valerie Thompson

Do you need more bandwidth to access the Internet from your home PC? Do you want Internet access from your TV? This year, Europe will see many new interactive services and Internet-access methods that give home users a variety of choices.

Digital satellite TV systems based on the Digital Video Broadcast (DVB) set of standards are making a big appearance this year. They enable access to broadband multimedia applications and "Internet over the air" services for PCs and TVs equipped with set-top boxes (STBs).



In France, for example, Canal Plus's C:Direct residential software broadcast service transmits 500 software titles to a subscriber's STB every month. Users can select the titles they want and pay for them via a credit-card-like on-line transaction over the telephone return channel. Out of Canal Plus's 500,000 digital TV subscribers, 10,000 users in France and nearly 4000 users in Spain subscribe to C:Direct.

Several of Europe's national carriers and alternative telecommunications operators are starting to provide access to the Internet over asymmetric digital subscriber lines (ADSLs) and cable TV modems. This is happening in France, Germany, Switzerland, the Netherlands, and Austria.

Media companies and equipment manufacturers are also launching Web services based on analog TV broadcast signals that go beyond the traditional teletext or videotext services. For example, MediaNet's NetOnAir, Intel's Intercast, and Philips' Webcast services use the vertical blanking interval (VBI) with its one-way 230-Kbps throughput to deliver selected "Best of the Web" content into European homes. Deutsche Telekom is working on a service delivery via the horizontal blanking interval (HBI). However, it will not be commercially available before 1999.

NetChannel, an Internet access and content provider, launched a European Internet-on-TV service in the U.K. last October. It builds on a standard TV, the telephone network, and an inexpensive STB for interactive Web access and e-mail. The company is also exploring cable TV networks in addition to the Public Switched Telephone Network (PSTN).

WebTV, a similar operation that also delivers Web services to TV and PC users via an STB, is planning its first European launch in the U.K. later this year.

The Bandwidth Problem

Digital Audio Broadcasting (DAB) is a possible broadband channel for consumers. Standardized by the European Telecommunications Standards Institute (ETSI) and the International Telecommunication Union (ITU), any combination of radio programs, data services, and Web content with a throughput capacity of up to 1.8 Mbps can be transmitted over a DAB network.

Although its downstream data transmission rate isn't suitable for MPEG-2 video compression, it is a reliable medium for datacasting and may well be used to stream MPEG-1 and other video formats that require less bandwidth. Offerings from early commercial services coming up on DAB networks this year in Europe will include electronic newspapers, selected Web pages, and stock information.

Many receiver and DAB-chip manufacturers will have products ready by the middle of the year. Product designers at radio equipment manufacturer Robert Bosch Multimedia Systems see DAB as a multimedia channel to deliver video to passengers on subways, trains, and minivans with its videocasting-over-DAB application. The idea is to deliver not only interference-free audio but also crisp TV pictures to moving vehicles. Trials performed in Sweden and Germany have shown that it is possible to deliver

ILLUSTRATION: EARL RIPLING © 1998

VCR-type video quality on 1.7-Mbps channels.

Hooking Consumers

Most of these services aim, at least initially, at PC users at home and in businesses, because of the PC's ability to efficiently process and display multimedia data. But the average home PC penetration rate of just 20 percent in Europe is a clear barrier to the growth of these new services.

That's why the media and computer industries are so excited about digital TV and so many electronics companies are in the STB business. Digital TV is widely seen as the first broadband path to the huge consumer market in Europe.

Digital TV satellites based on DVB may ultimately be the most promising distribution platform for multimedia services. They provide pure data-broadcast services and real-time interactive services, and may cover most of the world.

Digital direct-to-home satellite TV services are already available in Scandinavia, Germany, France, Benelux, and Italy. They offer digital bouquets from broadcasters such as Telepiu, DF1, Canal Plus, BSkyB, and TPS.

Canal Plus's C:Direct was the first to offer commercial data broadcasts over a digital TV satellite to consumers last year. News Corporation's technology subsidiary, NDS, started pilots in the U.K. last summer. Beta Business TV, an offshoot of Kirch Group's Beta Digital, and Pro Sieben Digital Media are offering business-oriented data-broadcasting services in Germany. Further broadband data services delivered via digital TV this year will come from Astra, called European Satellite Multimedia (ESM), and Eutelsat.

However, especially in urban areas, data broadcasting over digital TV will not replace wireless or cable networks. Instead, it will bring broadband multicasting to closed user groups or the distribution of Web data. "As an overlay network, it adds multicasting capabilities to the Internet," says Bernhard Collin-Nocker, a researcher at the University of Salzburg's department of computer studies.

Nearly 1000 broadcasters are using DVB satellites on five continents. DVB satellite data services use a broadcaster's extra satellite transponder space to broadcast data into the home. Users receive the data streams on their PCs via a standard 10,700–12,500-GHz satellite dish and a DVB-compliant STB or a DVB-compliant PC extension board.

Although DVB has the capacity to offer an overall throughput of up to 38 Mbps, most services available in Europe this year will use one 700-Kbps channel. To enhance bandwidth, the transponders carry a multiplex system that allows for the aggregation of multiple channels.

DVB data broadcasting lets you receive large multimedia files such as MPEG-2 video, multimedia-rich HTML pages, or large binary files. However, pure data broadcasting limits interactivity to what the service provider sends to everybody. In this case, STBs and PCs store broadcasted data locally, so you can browse, play back data, and select the files you want.

Better DVB Return Channels

Browsing the whole Web interactively, however, needs a return channel. That's why DVB satellite STBs are being equipped with modems. Users can interactively purchase a book, book a movie ticket, and browse the Web sites they want. In addition, the DVB consortium has already issued specifications for Digital European Cordless Telecommunications (DECT), Global System for Mobile Communications (GSM), and ISDN back channels. Says Martin Jaecklin of the DVB organization in Geneva, "The DVB data-broadcasting and return-channel specifications pave the way for a high-speed 'Turbo-Internet.'"

In the long term, DVB satellites will even be able to establish point-to-point connections with users' satellite dishes. The Astra consortium, for example, plans to launch later this year the Astra 1H satellite, which carries a Ka-band payload capable of communicating on the return path at 2 Mbps. Bidirectional satellite communications require a new receiver component in your satellite dish, but you don't have to replace the complete system.

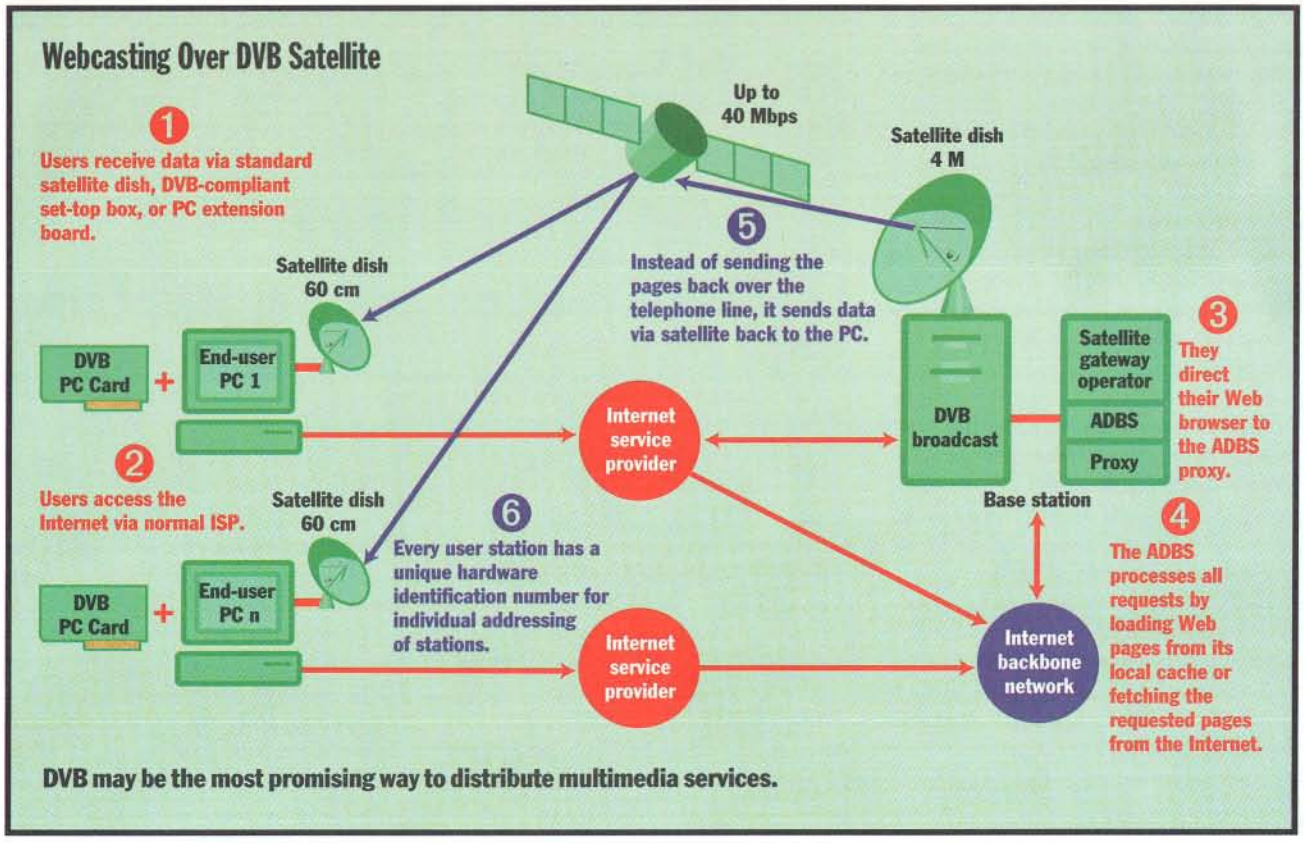
However, don't expect this functionality at your home anytime soon. The target markets will be large multinational organizations. According to an Astra spokesperson, "Fully interactive transmissions, allowing the bypass of terrestrial networks will be offered to business users in 1999."

In contrast to bidirectional satellite communications, service providers will commercially deploy asymmetric Web/satellite gateways such as AINS's Advanced Data Broadcast System (ADBS) this year. ADBS gives you full interactive Web access and supports unicast (i.e., point-to-point), multicast, and broadcast applications. The return link is usually a telephone line plus a modem to access an ISP. Eutelsat's Multimedia Platform, Italian RAI, and Com .Net say they'll offer ADBS-based services.

ADBS sits between a Web proxy server and the satellite uplink (see the figure on page 40IS 13). You configure your Web browser so that it directs all requests to this proxy server. The system then processes requests by loading Web pages from

More Ways to Access the Web

Web-Access Technology	Transfer Rate	Service Providers	Availability
Digital Video Broadcast (DVB)	Downstream: between 400 Kbps and 8 Mbps Upstream: currently, PSTN; eventually, ISDN, DECT, and GSM	ESM (Astra), Com.Net (Eutelsat), Canal Plus, Pro Sieben Digital Media	France, Spain, Italy, U.K., Germany
Digital Audio Broadcasting (DAB)	Downstream: 1.8 Mbps Upstream: 9.6 Kbps (over GSM)	Public broadcasters	Later this year, in Scandinavia and Germany. In 2001, all over Europe, parts of India and China.
Datacasting via VBI	Downstream: 230 Kbps Upstream: PSTN	NetOnAir (MediaNet), Intercast (Intel), Webcast (Philips)	Today, in most of Europe (over Eutelsat and Astra)
Datacasting via HBI	Downstream: 152 Kbps	Deutsche Telekom	Today, Frankfurt Broadcast On-Line TV (BOT) trial; 1999, commercial service in Germany



its local cache or fetching the requested pages from the Internet. Instead of sending the pages back over the telephone line, it sends data via satellite back to the PC.

ADBS supports several levels of conditional access, security, and privacy. Only authorized users may connect to the proxy, which serves users according to the scheduling strategies implemented by the system manager. Every user station has a unique hardware identification number that is used for individual addressing of stations. The current implementation can deliver data at a rate of about 8 Mbps.

A Carousel of Multimedia Data

DVB systems deliver multimedia streams, including compressed video and audio. Expressed in more technical terms, DVB's specification is based on the MPEG-2 Digital Storage Media Command and Control (DSM-CC) in combination with the DVB Service Information standard. DSM-CC is a set of ISO/IEC 13818-6 protocols that are independent of the transport layer. This lets applications be delivered over a multitude of broadband networks.

DSM-CC comprises four generic application-delivery mechanisms. The Data Carousel protocol periodically broadcasts data to the DVB decoders. It sends a list of available modules, so that each client can identify the appropriate software modules to download.

This mechanism doesn't require a return channel from client to server, because the decoder software receives all the relevant control information (e.g., start time and channel number) from the DVB server. Although the Data Carousel was originally intended to access multimedia libraries, it has been adapted for first-generation "Internet over the air" services on the upcoming digital TV networks. It provides an efficient way to make multimedia Web sites available to a large audience without increasing Internet traffic.

However, the Data Carousel's revolving data broadcast is not appropriate for interactive applications. DVB offers three alternatives for interactivity. All of them involve encapsulating or wrapping data inside several headers.

The Data Piping mode transports nonsynchronized bit streams. Data Streaming supports synchronous data. The Multi-Protocol Encapsulation transport mechanism best supports various packet-switching protocols. Note that you can use any one of these protocols to transfer TCP/IP data packets. Most of the recent interactive DVB Internet trials that offer a broadband back channel via cable or ADSL modem have used Multi-Protocol Encapsulation, although some have also deployed the Data Carousel.

The flexibility of DVB broadcasting protocols is inspiring a good deal of development work in Europe and the U.S. "A lot of researchers are working on DVB-based solutions for broadband Internet access," says Collin-Nocker, who has conceived several experimental DVB design studies and product prototypes. According to Collin-Nocker, many product studies use DSM-CC to transmit IP. Some products, however, use the Packetized Elementary Stream (PES) protocol.

In contrast to DSM-CC, PES contains timing information to synchronize different data streams and allows for selective coding of control information. PES is more efficient than DSM-CC, but not all MPEG-2 chips can reassemble PES packets. AINS's SatServer, for example, is based on PES. New DVB products from Nokia, IBM, ComAtlas, and Sat/Sagem are also expected to use this protocol.

Home Networks

The STB is the central relay station in the multimedia home envisioned by digital

TV proponents. It not only receives digital TV signals from the satellite dish, it also handles e-mail communication, Web browsing, and general multimedia decoding in a couch-potato environment.

Various STB designs have emerged from vendors such as Sat/Sagem, Nokia, Sony, Pace, and Acorn during the last three years. Features vary, but all have interfaces to the PC. Sat/Sagem, for example, uses a bidirectional, asynchronous parallel interface (IEEE-1284), where others deploy RS-233 or SCSI ports.

In the near future, however, these boxes will most likely have an IEEE-1394 FireWire connector. This enables several STBs and other multimedia devices to be connected to each other. The decoder would then function much as a hub for all the in-home networks and services.

But before an STB can become the multimedia platform of the home, it needs a certain level of hardware and software standardization. "Only a common STB standard will allow consumers to receive content from a wide range of service providers and broadcasters," says Graham Mills of BT.

Although today every vendor uses its own set of APIs, there are some solid candidates for a standard API. The Digital Audio/Video Council (DAVIC), for example, promotes an API based on ISO standard MHEG 5 (Multimedia and Hypermedia Information Coding Expert Group) and Java, now called MHEG 6. According to Philip Laven, director of the EBU technical department, "Several DVB members seem to favor the choice of an open API based on MHEG 5 and Java."

WHERE TO FIND

Acorn
Cambridge, U.K.
+44 1223 725005
kcoleman@acorn.com
http://www.acorn.com

AINS
Vienna, Austria
+43 1 545 46 60
fax: +43 1 545 46 45
office@ains.at
http://www.ains.at/

C: Direct
Paris, France
+33 1 45 78 47 56
fax: +33 1 45 78 47 66
tlc@cplus.fr
http://www.cpp.fr

DirecPC
Milton Keynes, U.K.
+44 1908 319101
fax: +44 1908 221127
info@hns.com
http://www.hns.com

ESM
Chateau de Betzdorf, Luxembourg
+352 71 98981
fax: +352 71 9898 7610
hmelze@astra-net.com
http://www.astra-net.com

Intel
Feldkirchen, Germany
+49 89 99143 0
fax: +49 89 9043948
info@intercast.com
http://www.intercast.com/

MediaNet
Brühl, Germany
+49 22 32 945910
fax: +49 22 32 9459128
medianet@flix.de
http://www.medianet.freinet.de

NetChannel U.K.
London, U.K.
+44 171 591 7000
fax: +44 171 581 7001
enquiries@staff.netchannel.co.uk
http://www.netchannel.co.uk

Philips Data Broadcasting
Eindhoven, The Netherlands
+31 40 2742817
fax: +31 40 2742786
dbs@natlab.research.philips.com
http://www.nbsp.philips.com/dbs/

Another candidate for an STB API standard is OpenTV, developed by the company of the same name, a software solution company that's owned by Myriad International Holdings, Thomson Multimedia, and Sun Microsystems. OpenTV is expected to come out with its first detailed specification of an open API soon. The company has already announced that it intends to develop STB reference designs based on Sun's MicroSparc and JavaChip processors. In either case, it's likely that the next generation of STBs will capitalize on Java's virtual machine.

Super TV

While many companies are working on standardizing separate STB designs, a lot of the functionality is moving into TV sets. With an internal storage capacity, signal processing, and MPEG-2 decoding, this integrated design is called the smart TV or super home TV.

Says Peter Bondar, senior vice president for technology and engineering at Acorn, "For the stand-alone home market, the network computer (NC) has lost its opportunity, at least in the volumes that were originally conceived. But there are now new types of devices emerging that rely on the NC concept."

Super home TV systems have e-mail, Web browsing, picture-in-picture (PIP) functionality, videoconferencing, home automation, fax, and voice messaging.

Says Acorn's Bondar: "We expect product designs to quickly cluster around the key concepts of super home TVs." B

Valerie Thompson is a freelance writer based in Zurich, Switzerland. You can contact her at **vthompson@spectraweb.ch.**

Enter HotBYTEs No. 151 at http://www.byte.com/hotbytes/

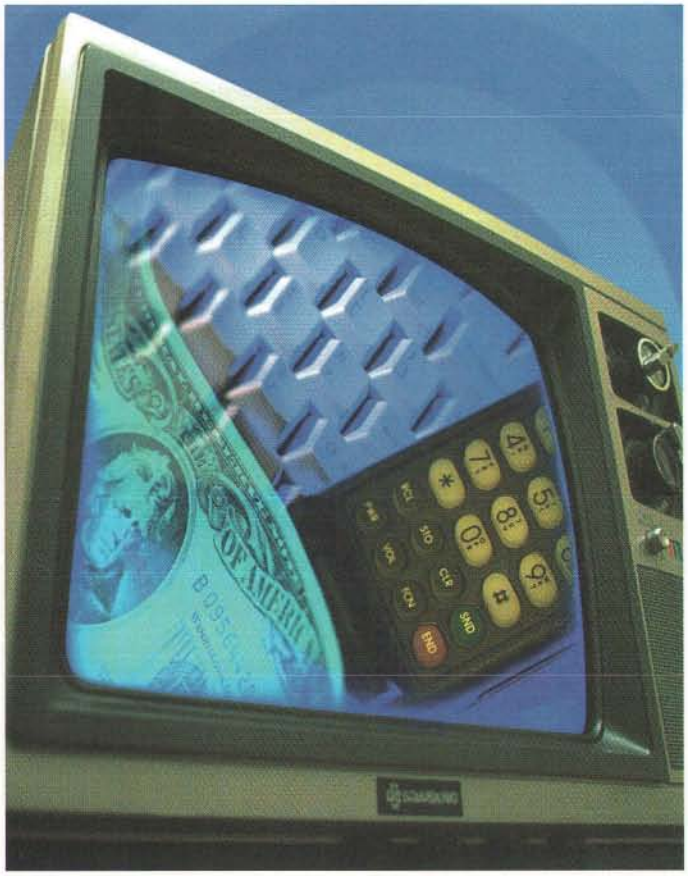
Speedy Wireless Networks

10-Mbps wireless LANs are coming, and they can carry complex audio and video applications.

By Stella Kao

Compared to wired networks, which have developed rapidly, the wireless LAN, which quietly celebrated its seven-year anniversary recently, is still in the dark ages. Stifling the growth and popularity of wireless LANs are their low speed, high costs, limited range, and the fact that most of them are incompatible. In addition, wireless technology has a reputation for being complicated to install.

As a result, wireless technology today is confined to temporary setups. It's showing up mostly in places such as stock-trading floors, hospitals, and campuses, where cabling should not or cannot be installed for aesthetic, regulatory, or safety reasons.



Other potential sites for wireless technology include warehouses, airports, and railway stations—places where data is usually input into laptops or hand-held devices and consolidated with central databases upon completion of a task. However, vendors say that wireless technology's flexibility benefits are just not great enough to outweigh the limitations of the technology's 1- to 2-Mbps speed. "Users certainly do not want to trade in a 10- or 100-Mbps Fast Ethernet LAN for a much slower 2-Mbps one," says Roy Chen, system manager of Z-Com, a company based in Taiwan.

New Standards

But if wireless LANs offered 10-Mbps throughput, their acceptance could grow quickly. The industry is currently working on standards that will make wireless products easy to use and fast, much the same as wired-LAN products. Seven years in the making, the IEEE 802.11 standard was finally formalized last June, when it was approved by the IEEE committee. The specification defines a single media-access-control (MAC) layer with three different physical-layer (PHY) options: infrared plus two spread-spectrum implementations at 2.4 GHz. In addition, it defines transmission procedures, throughput requirements, range characteristics, and configuration issues.

The IEEE 802.11 specification could succeed in unifying vendors for the first time. The new wireless standard has gained wide support from a large number of companies, including AMD, Digital Equipment, Harris Semiconductor, Oki Semiconductors, and Philips Semiconductors. Moreover, the standard will enable chip houses to implement single solutions that should help bring down the price of wireless technology.

Indeed, some of that has taken place already. For frequency hoppers, NetWave and AMD announced a one-chip solution conforming to the IEEE standard the day after it was ratified. "The standard will have a significant impact on the wireless marketplace by driving component costs down by 50 percent for single-chip solutions and making it easier to extend enterprise LANs to the growing number of mobile-computer users," says Ralph Yang, president of Taiwan-based DB Networks.

Ultimately, the specification could lead to steady growth in vertical markets and to broader adoption by the corporate world. New standards-based hardware is not expected to begin shipping in volume until the first quarter of this year. Vendors have already begun compliance and interoperability testing. But 802.11 does not encompass all the issues surrounding wireless LANs, so products from different vendors supporting this standard might not be compatible.

For devices operating at speeds higher than 2 Mbps, a project-authorization request (PAR) has been submitted to the IEEE for an extension of the 802.11 standard that will define speeds up to 10 Mbps. Another PAR is being submitted for a 20-Mbps wireless standard in the 5.2-GHz range. The FCC recently approved a new spectrum of unlicensed wireless communications in the 5.2-GHz band for use in the U.S. One company, RadioLAN, prom-

ILLUSTRATION: EARL RIPLING © 1998

ises to soon deliver products that will operate in that band.

RF Technologies

Of the three physical-layer connections defined for spread-spectrum links, infrared gets the smallest amount of support from vendors. Infrared is capable of high speeds, uses laser infrared transmitters, and supports two types of devices: dispersed and line-of-sight. However, this technology has been relegated to a niche role because of the high cost of lasers and health concerns about laser use.

As a result, spread-spectrum radio-transmission technology has moved into a dominant position in the market. As its name indicates, spread-spectrum technology spreads the transmitted power over a wide range of the available spectrum. Therefore, it avoids a concentration of power in a single narrow-frequency band.

The two radio designs now in use are frequency hopping (FH) and direct-sequence modulation (DSM) spread-spectrum. Each design has its supporters. DSM lets vendors avoid excessive power concentration by spreading a signal over a wide frequency band. The transmitter maps each bit of the message into a pattern of "chips." At the destination, the chips are mapped back into a bit, re-creating the original data.

Hence, the transmitter and receiver must be synchronized to operate proper-

Here Comes 10-Mbps Wireless Throughput

During the past year, major players in the wireless arena, including Aironet Wireless Communications, Lucent Technologies, Proxim, RadioLAN, and Xircom, have been working to develop 10-Mbps products, in a move to bring wireless technology on a par with wired LANs. The arrival of 10-Mbps technology is expected to give wireless LANs the ability to carry high-quality audio and video applications along with high-speed data transmissions.

RadioLAN is one of a few companies working on higher-speed products using the company's narrowband RF 10BaseRadio technology. Last year RadioLAN shipped 10-Mbps wireless LAN adapters and access points, and this month it's scheduled to complete beta testing of its 10-Mbps PC Card adapters.

The patented Direct Sequence/Pulse Position Modulation (DS/PPM) technology is the only system that's backward compatible with lower-capacity wireless LANs built to the IEEE 802.11 wireless standard. At five times the transmission speed of current wireless LANs, DS/PPM can liberate users whose need for data-intensive applications has kept them tied to a desktop workstation.

The technology was created in Lucent's Bell Labs facility in the Netherlands. By combining direct-sequence and pulse-position modulations in the same signal, the number of logical possibilities in each cycle is multiplied. This, in turn, multiplies the amount of data the signal can carry without increasing the required bandwidth. It uses a modulation technique that lets wireless receivers detect several distinct pulse positions in an incoming data stream, multiplying the amount of data that can be sent in the same bandwidth.

RAIDstation: You'll Never Outgrow It

As your company grows, your RAID storage subsystem needs to keep pace. DPT's new family of RAIDstation storage arrays is designed with the future in mind, offering the optimum in features, growth path, flexibility and capacity.

RAIDstation provides a comprehensive suite of fault tolerant features including subsystem environmental monitoring, hot swappable redundant power supplies and dual advanced cooling modules. Purchase DPT's hard drives featuring capacities up to 18GB or buy the carriers and install your own SCA-2 drives.

Start with either the 7- or 14-bay tower arrays, and store up to 126GB or 252GB in one enclosure. As your storage needs grow, convert the tower arrays to standard rack-mount units quickly and easily. These units can be mounted in DPT's 7-, 10- or 14-rack cabinets that provide room for up to 1.7 terabytes of data.

For the ultimate in compatibility and performance, combine RAIDstation storage arrays with DPT's high-performance SmartRAID controllers.

Call us for more information and technical specifications on RAIDstation Storage Arrays or visit our web site to find your local distributor.

Tel: 407-830-5522 (U.S.)

DPT

DISTRIBUTED PROCESSING TECHNOLOGY
140 Candace Drive
Maitland, FL 32751 USA
FAX 407-260-6690
sales@dpt.com
www.dpt.com

RESELLERS
Contact your Distributor for promotion details

Limited Time Offer:
Buy a RAIDstation Storage Array and get a FREE SmartRAID IV Controller*

* Purchase a RAIDstation7 storage array with at least 3 hard drives and receive a free DPT PCI SmartRAID IV controller (PM3334UW valued at $1,492 US). Limit one controller per customer. This offer cannot be combined with any other promotion. Offer ends March 31, 1998.

B9803I

Enter HotBYTEs No. 144 at http://www.byte.com/hotbytes/

WHERE TO FIND

DB Networks, Inc.
Taipei Hsien, Taiwan
+886 2 268 2081
fax: +886 2 267 1859
http://www.dbtel.com.tw

Lucent Technologies
Nieuwegein,
The Netherlands
+31 30 60 97 464
fax: +31 30 60 97 636
http://www.wavelan.com

National Datacomm Corp.
Hsinchu, Taiwan
+886 3 578 3966
fax: +886 3 577 79889
http://www.ndclan.com.tw

Z-Com, Inc.
Hsinchu, Taiwan
+886 3 577 7364
fax: +886 3 577 3395
http://www.zcom.com.tw

ly. The ratio of chips per bit is called the *spreading ratio*. A high spreading ratio increases the signal's resistance to interference, while a low ratio increases the bandwidth available to the user.

Lucent Technologies is an advocate of the DSM method because of its higher throughput capability. "DSM can reach 10 Mbps, while FH becomes saturated at 3 Mbps," explains Jan Haagh, senior product manager for WaveLAN at Lucent.

Most Taiwan product makers agree with Lucent. "DSM will become a leading technology this year," says DB Networks' Yang. DSM might climb to even higher speeds this year, he adds.

The FH technology spreads a signal by transmitting a short burst on one frequency. It allows a data signal to "hop" from channel to channel. Because there are many possible sequences in the 2.4-GHz band, FH allows many nonoverlapping channels to be deployed. However, the source and destination of a transmission must be synchronized so that they're on the same frequency at the same time.

Hopping patterns and dwell times are restricted by most regulatory agencies. For example, the FCC stipulates that at least 75 frequencies must be used, with a dwell time of 400 milliseconds. If interference occurs on one frequency, the data is retransmitted on a subsequent hop on another frequency.

Some vendors who use the FH approach claim it offers better security and less interference than DSM. Because the signal is constantly hopping within the frequency band, the chances of a transmission's being interrupted by noise or other types of interference are less likely. Also, FH products can operate on a lower-powered battery and can be less expensive to implement.

Speed vs. Distance

The issue of speed versus distance is an important one. Most wireless LAN links average between 1- and 2-Mbps rates, and wireless LAN transmitters typically have a transmission range of just 500 to 1000 feet within a building. For most applications, the current speeds are sufficient, National Datacomm's Chiang contends. As 2-Mbps wireless LANs evolve, products yielding between 3 and 7 Mbps are expected to come to market. And 10-Mbps technology is not far behind.

Bell Labs, the R&D arm of Lucent, has developed Direct Sequence/Pulse Position Modulation (DS/PPM), a new technology that can significantly boost wireless-LAN data rates up to 10 Mbps without shortening the distance over which wireless LANs can transmit data. The new wireless-LAN nodes will be fully backward-compatible with IEEE products that operate at 2 or even 1 Mbps. The 10-Mbps technology will let more-data-intensive applications run over wireless LANs and will also make it possible for more users to go wireless. B

Stella Kao is a BYTE contributing editor based in Taipei. You can contact her by sending e-mail to **meou@e-mail.gcn.net.tw.**

Rapido, Schnell, Hayaku, Fast.

In Every Language, Velocis™ Means 'Fast Database'

For years, serious C and C++ programmers have called on Raima's DBMS when they want the ultimate in database performance. Now your Visual Basic, Java or Delphi application can incorporate Raima's highly optimized engine and get the same advantages: low cost, portability, low memory requirement, compact executables. And data access an order of magnitude faster than other databases.

Want faster applications?
We're talking your language.

Visit our Web Site at:
www.raima.com
or call 1-800-327-2462

If it's fast–it's
RAIMA™

INTERNATIONAL

What's New

Hardware

This month we look at remote control for multiple PCs, and a Heitml Web development tool.

PREVIEW

CyberGear
Starts at £750
(six users, two ISDN lines)

Enter HotBYTEs No. 976.

Network Alchemy
Watford, U.K.
+44 1923 699000
fax: +44 1923 699039
sales@networkalchemy.co.uk
http://www.networkalchemy.co.uk

CyberGear Integrates Telephony and IP Routing

As data and voice environments converge and client/server telephony platforms emerge, the management and configuration of LANs is becoming even more complicated. But Network Alchemy's CyberGear shows that setting up and managing telephony-enabled networks doesn't need to be complicated at all.

The device scales from six to 96 users and combines the functionality of a PBX with that of an IP router. The PBX provides full call-processing features, plus voice mail and call logging. The router includes a firewall and supports DHCP, which automates the management of IP network addressing. An installation wizard and an external control panel handle the rest of the setup procedure.

The tight integration between the PBX and the IP router enables computer telephony (CT) features, such as unification of voice mail, e-mail, and faxes into one in-box; automatic outbound dialing; and display of contact information for inbound calls. Automatic Network Address Translation lets several users access the Internet with one preconfigured or dynamically assigned IP address.

CyberGear is a stackable system that uses multiple basic-rate interfaces to match the trunk capacity and supports a full 30-line PRI configuration. In this high-end configuration, it also includes Ethernet hub functionality and WAN compression. It's also available in an entry-level product for staff working from home.

The CyberGear system comes with a separate switch, router, and hub. This means that Internet access, data routing, and CT applications are effectively free. **–Bob Emmerson**

Communications

PC Card Modem for Macs and PCs

THE LASAT CREDIT 560 COMMUNICATIONS PC Card supports PCs and Macs. The card automatically installs itself when you switch on your mobile computer. It supports 56Kflex, V.34, and ISDN, and it offers flash memory for easy upgrades to emerging standards, as well as a voice environment that enables you to use your computer like a telephone.
Price: £169.
Contact: Lasat, Nibe, Denmark, +45 9671 1099; http://www.lasat.com.
Enter HotBYTEs No. 978.

Portable Videoconferencing Set

THE MM120 ISDN-BASED VIDEOCONFERENCING system includes a portable set-top box, a remote control, and a separate camera. Compatible with the H.320 standard, it works with standard TV sets and accepts video input from external cameras and VCRs. In addition, it can switch between inputs during a call, and it supports the T120 industry standard for data sharing via PCs.
Price: £1000.
Contact: Motion Media Technology, Bristol, U.K., +44 1454 313 444; http://www.motionmedia.co.uk.
Enter HotBYTEs No. 980.

EAS Links SNA Networks

EICON'S ENTERPRISE ACCESS SERVER (EAS) 3.1, a rack-mountable communications server, facilitates the migration of SNA networks from leased and switched lines to ISDN. It connects to an SNA host via Token Ring or Ethernet and is designed to replace SDLC links with ISDN. EAS supports up to four ISDN PRI connections, which are active only during data transfer. Through 3270 and 5250 terminal emulation, as well as APPC links, you can easily connect remote clients.

Price: Call company.
Contact: Eicon Technology Corp., Harlington, Hayes, U.K., +44 181 967 8000; http://www.eicon.com/.
Enter HotBYTEs No. 977.

Networking

Zero-Hop Intranet Switch

POWEROFFICE, AN INTRANET SWITCH FOR branch offices and small offices, provides IP cut-through (i.e., Zero-Hop) routing as well as standard packet-based IP routing. It comes with either 16 Ethernet ports or eight Ethernet and two Fast Ethernet ports. The product can operate as a stand-alone IP switch or in a stack and allows peripheral IP devices to exchange data via network switches. With PowerOffice, stations on different IP networks can communicate directly without the need for an additional router.
Price: Starts at US$8950.
Contact: R.N.D. Networks, Ltd., Tel Aviv, Israel, +972 3645 8555; http://www.rndnetworks.com.
Enter HotBYTEs No. 981.

Printer Interface to Ethernets

IF YOU WANT TO INTEGRATE YOUR PRINTER into an Ethernet network, try the Intercon-IC9-Etherprint adapter. You simply plug it into the parallel Centronics interface of the printer to gain access to the network. The complete configuration of the device is handled in a NetWare, Unix, or Windows NT environment via a standard Web browser.
Price: DM 520.
Contact: SEH Computertechnik, Bielefeld, Germany, +49 521 942 260; http://www.seh.de.
Enter HotBYTEs No. 983.

Peripherals

Remote Control for Multiple PCs

PROVIDING CONTROL AND MONITORING FOR up to eight AT and/or PS/2 computers, the SmartViewPro multiple CPU controller automatically launches the appropriate PC emulation. Multiple units can be stacked together to provide support for up to 256 computers. An on-screen display menu lets you switch easily between machines. The controller maintains good picture quality through the extensive use of high-bandwidth video multiplexers.
Price: £775.
Contact: Adder Technology, Ltd., Cambridge, U.K., +44 1954 780 044.
Enter HotBYTEs No. 988.

Storage

CD Writer for Parallel and PC Card Ports

THE LATEST MEMBER OF FREECOM'S IQ family of external CD writers can connect to either a PC Card or a computer's parallel port. These devices host I/O circuitry in the peripheral cables instead of inside the drives. Thus, when you replace the cable, the devices connect to both ports. The 6X read and 2X write drives feature an average access time of 200 ms and support the upcoming Universal Disc Format (UDF), which makes handling a CD-R as easy as handling a hard disk.

Price: DM 890.
Contact: Freecom Computer Peripherie GmbH, Berlin, Germany, +49 30 611 299 31.
Enter HotBYTEs No. 986.

Monitors

Color-Calibration Monitor

ADDRESSING GRAPHIC DESIGN, DIGITAL ART, and print-production management, Hitachi's 19-inch CM751ET monitor comes bundled with Linotype's ViewOpen ICC color-calibration software. This combination allows for efficient color management in accordance with ICC standards and achieves output results that exactly meet the color tones displayed on the monitor.
Price: DM 2798.
Contact: Hitachi, Düsseldorf, Germany, +49 211 529 1550.
Enter HotBYTEs No. 991.

Large Plasma Screen

THE PLASMA SCREEN COMPANY NOW OFFERS plasma screens in 40- and 42-inch formats. Designed to work in normal daylight conditions, they include a camera and built-in speakers for videoconferencing.

Price: From £10,000.
Contact: The Plasma Screen Co., Ltd., Reading, U.K., +44 7000 752 762.
Enter HotBYTEs No. 985.

DAQ Made Simple

with DAQ Wizards in LabVIEW™ 4.1

NEW

Today, thousands of users are successfully using LabVIEW, the world's leading instrumentation software package, in their data acquisition (DAQ) systems. Now, with the **new DAQ Wizards in LabVIEW 4.1,** successful DAQ applications are easier than ever. From the time you open the LabVIEW package, you are only a few minutes and a few mouse clicks away from a custom solution designed for you. Whether you are looking for a temperature monitoring system, a PC-based multimeter, oscilloscope, or waveform generator, or countless other applications, LabVIEW 4.1 has you up and running in a fraction of the time it takes with other software. Discover how the new DAQ Wizards bring you instant success!

Free LabVIEW 4.1 Evaluation Package

www.natinst.com/mags/labview41.htm

LabVIEW – It's Just That Easy

NATIONAL INSTRUMENTS™
The Software is the Instrument™

European Branch Offices:
Austria 0662 45 79 90 0
Belgium 02 757 00 20 • **Denmark** 45 76 26 00
Finland 09 527 2321 • **France** 01 48 14 24 24
Germany 089 741 31 30 • **Italy** 02 413091
Netherlands 31 348 43 346 6 • **Norway** 32 84 84 00
Spain 91 640 0085 • **Sweden** 08 730 49 70
Switzerland 056 200 51 51 • **U.K.** 01635 523545

U.S. Corporate Headquarters
Tel: (512) 794-0100 • Fax: (512) 794-8411
info@natinst.com • www.natinst.com
Worldwide network of direct offices and distributors.

© Copyright 1997 National Instruments Corporation. All rights reserved.
Product and company names listed are trademarks or trade names of their respective companies.

SOFTWARE

Networking

Teemworld Provides Secure Authentication

TEEMWORLD IS A JAVA-BASED HOST CONnectivity package that offers full 128-bit key encryption for secure host-to-desktop data exchanges. It supports Secure Sockets Layer (SSL), so two applications can authenticate each other. Teemworld comes as a trusted Java applet, a JavaBean, or a GUI-based system.
Price: Call company.
Contact: Pericom Software plc, Milton Keynes, U.K., +44 1908 265 533; http://www.pericom.co.uk.
Enter HotBYTEs No. 997.

Internet for All

INTERNET CONTROLLER, A PROXY SERVER, offers simultaneous Internet access for up to 254 LAN users via a single dial-up connection and Internet account. Each user retains private e-mail facilities. The server requires a TCP/IP stack and Windows NT/95 at each client and includes a configurable firewall. A special caching algorithm speeds up Web browsing and file transfers.
Price: £165 for a five-user license.
Contact: Digicorp, Surrey, U.K., +44 1372 844 151; http://www.digicorp.co.uk.
Enter HotBYTEs No. 998.

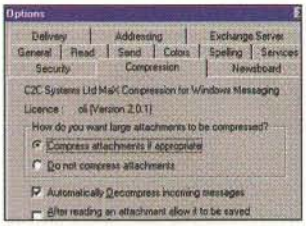
Communications

Automatic E-Mail Translation

MAKING GLOBAL E-MAIL COMMUNICATIONS easier, TFS Translator, a plug-in for TFS Gateway, automatically translates e-mail from German, French, Spanish, Portuguese, or Italian into English and vice versa. After you've specified the receiver's native language, TFS Translator sends the original message with the translation attached. This 32-bit package supports all common text formats as well as HTML and integrates with other e-mail platforms, such as Exchange, Notes, cc:Mail, GroupWise, and MHS.
Price: DM 2500 for a five-user license.
Contact: TenFour, Norderstedt, Germany, +49 40 55 484 126; http://www.tenfour.de.
Enter HotBYTEs No. 993.

E-Mail Compression Utility

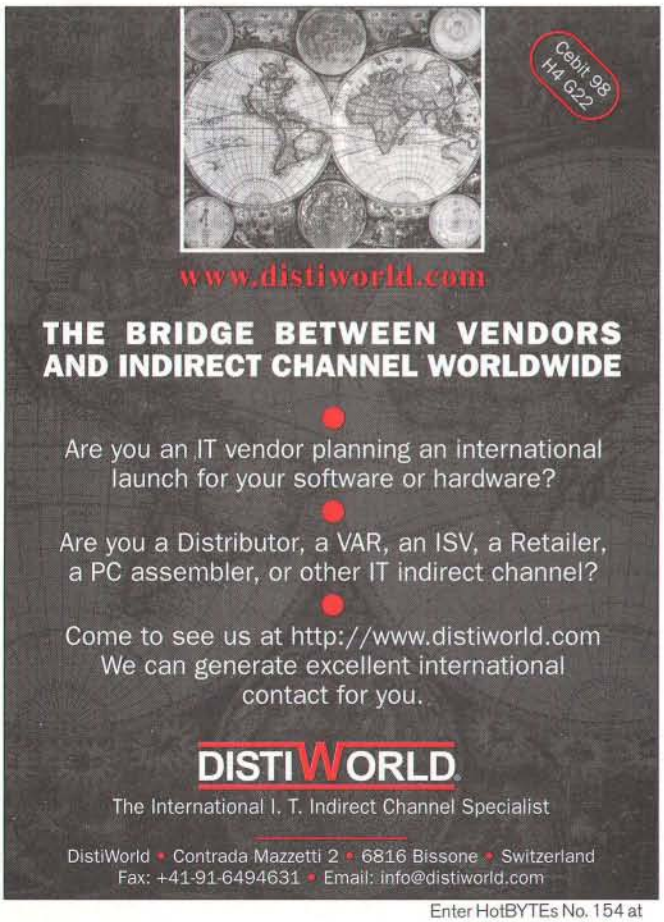
MAX COMPRESSION COMPRESSES ALL FILES attached to Exchange and MS Mail messages. The latest version, 2.0, is optimized for large networks and enables easy network installation. According to the company, MaX Compression can reduce transmission times by up to 65 percent.
Price: Starts at £295.



Contact: C2C Systems, Ltd., Reading, U.K., +44 118 951 1211; http://www.c2c.co.uk.
Enter HotBYTEs No. 995.

E-Mail Server for Small and Medium Enterprises

SMARTSERVER ENABLES SMALL- AND MEDIum-size enterprises to seamlessly integrate Internet- and LAN-based e-mail without upgrading hardware. Because SmartServer supports standard Internet and proprietary interfaces, TCP/IP needn't be installed on every client machine. The system redirects incoming messages to users according to predefined rules and filters and can



Moving?

To change your subscription mailing address, please complete the form below and send it to:

BYTE Subscriber Services
PO Box 555, Hightstown NJ 08520 USA
Fax: 609-426-7087
Phone (9 a.m. to 8 p.m., Eastern Time, Mon-Fri.)
609-426-7676

Current/Old Address:

Account Number
Name
Company
Address
City/Code/Country

PLACE MAILING LABEL HERE

New Address:

Name
Company
Address
City/Code/Country

Please allow up to 8 weeks for this change to become effective.

BYTE

A Division of The McGraw-Hill Companies

Enter HotBYTEs No. 154 at http://www.byte.com/hotbytes/

automatically respond to incoming requests.
Price: £425 for a five-user license.
Contact: NetcPlus Internet Software, Ltd., Milton Keynes, U.K., +44 1908 698 228; http://www.netcplus.com.
Enter HotBYTEs No. 994.

Year 2000

Check 2000 Analyzes Millennium Bugs

DESIGNED AS AN EARLY-WARNING SYSTEM for year-2000 problems, Check 2000 is for companies that want to assess the millennium bug risks of their PC installations. It performs six hardware-level BIOS tests, including whether a PC will successfully roll over to 2000 and whether it recognizes it as a leap year. The utility is available in a single-desktop version as well as a client/server version for large networks.
Price: Starts at £50.
Contact: Chase Technology plc, Twickenham, U.K., +44 181 831 6800; http://www.chase-tech.com.
Enter HotBYTEs No. 1001.

PREVIEW

Heitml
$350 for server

Enter HotBYTEs No. 992.

H.E.I. Informationssysteme GmbH
Mannheim, Germany
+49 621 79 51 41
fax: +49 621 79 51 61
http://www.heitml.com

Extensible Web-Development Platform

Heitml (pronounced "Hi-TML") extends the functionality of HTML through the use of user-definable tags and programming features. This enables dynamic content and database applications without CGI or other scripting or programming languages. Heitml runs on a Web server and dynamically generates HTML.

Heitml, short for extended interactive HTML, is both a Web database interface and an extended markup language that eliminates cumbersome CGI and Perl scripting or ISAPI programming. By providing powerful tag libraries, it shields Web-site developers from complex server processes, such as scrolling databases or handling mail forms.

Heitml stores the values of variables from one page to another, which makes it easy to keep track of user requests during an entire session. This makes Heitml suitable for building complete on-line shopping applications. Because performance is a critical issue with such applications, the package integrates with the ISAPI interface, which means that the system is directly linked to Microsoft's Internet Information Server. Under Unix, Heitml can be linked directly to Apache. Other Web servers are supported via CGI.

Heitml's syntax resembles HTML but is extensible and lets you create your own tags. Advanced programmers can use Heitml like a procedural programming language to create comprehensive tag libraries. This approach makes Heitml suitable for HTML newcomers and professional programmers alike. **–Rainer Mauth**

Engineering

Process Controller Supports OLE

SIMATIC WINCC, A SCADA SYSTEM, NOW offers enhanced graphics-design, alarm-logging, tag-logging, and control-center features. It also allows for redundancy checks in installations with two WinCC servers. Other features include OLE for Process Control (OPC) support and easy data exchange between production and office applications.
Price: Call company.
Contact: Siemens A&D, Nürnberg, Germany, +49 911 895 2666; http://www.ad.siemens.de/wincc.
Enter HotBYTEs No. 1002.

Graphics

Vectors for the Web

XARA WEBSTER 2 IS A VECTOR-BASED graphics package that now includes a quick-shaping tool, for the creation of regular shapes; a Bézier curve editor; and a text tool. You can export your drawings to the emerging PNG vector format or to Xara's Web vector format. Support for import files includes JPEG, GIF, and animated GIF. Because the package works with vector data, files remain small in size, an advantage for Internet use.
Price: Starts at £30.
Contact: Xara, Ltd.,

Hempstead, U.K., +44 1442 350 000; http://www.xara.com.
Enter HotBYTEs No. 999.

Business

Sextant Helps Develop Business Strategies

THE SEXTANT MANAGEMENT AND MONITORING tool is designed to assist companies with developing and implementing effective business strategies. Its dynamic links between daily business decisions and unscheduled events help you to forecast market opportunities and develop efficient marketing strategies. The software runs under Windows 3.1, 95, and NT.
Price: Call company.
Contact: Softa, St. Albans, U.K., +44 1727 863 234; http://www.softa.co.uk.
Enter HotBYTEs No. 1004.

Alice Integrates with the Web

ALICE, A DATA-MINING TOOL BASED ON decision trees, now permits you to visualize query results via a standard Web browser. It also runs in a client/server mode over the Web, so you can interactively access Web databases.
Price: Call company.
Contact: ISoft, Gif sur Yvette, France, +33 169 35 37 37; http://www.alice.fr.
Enter HotBYTEs No. 1003.

INTERCON® - PRINTSERVER

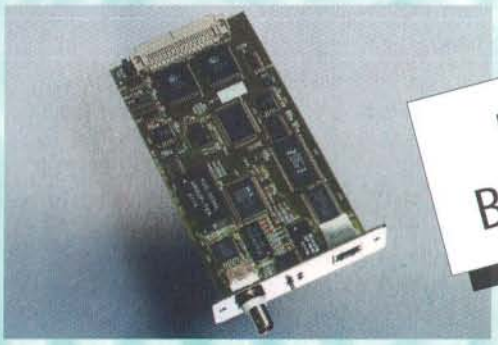
For Excellent Connections

yes NetWare Tested and Approved | Microsoft Windows | Microsoft Internet Explorer | CE | Made in Germany

CeBIT98 HANNOVER 19. — 25. 03. 1998

Features

- Configurable with any HTML 3.x Internet browser
- Multiprotocol support of all operating systems
- Automatic recognition of the used network connector
- Software update/upgrade via download in Flash-EPROM
- Printer status request from host computer
- Automatic protocol recognition
- Configuration parameters can be edited by software
- Configuration via printer operation panel (for KYOCERA)
- Recognition and reaction to network environment changes
- Supports 16 queues on 16 servers (Novell)
- Support of 8 logical printers
- Easy Installation via PCONSOLE (Novell)
- Status button



Hall 11
Booth F06

Multiprotocol Software Support

- **Novell NetWare** (IPX)
  - Novell 2.x, 3.x, 4.x Bindery Mode
  - Novell 4.x NetWare Directory Services (NDS)
- **Novell NetWare** (SPX)
  - Novell 3.x RPRINTER
  - Novell 4.x NPRINTER
- **SNMP** (MIB II and SEH Privat MIB)
- **HTML/HTTP** configurable
- **UNIX** Support of LDP, FTP or Socket Printing (TCP/IP)
- **Apple** Ether/TokenTalk
- **Windows NT** (TCP/IP)
- **Windows '95** (TCP/IP / SEH PrintMonitor)
- **BS2000 RSO Spool** (V. 2.3A, V. 3.0A)
- **DHCP** (TCP/IP)

Hardware Support

Ethernet 10Base2/5/T/FL (BNC, AUI, RJ45, ST)

- IC53-ETHER-KYO
- IC53-ETHER-KYO-5
- IC53-ETHER-KYO-FL
- IC55-ETHERPOCKET
- IC57-ETHER-EPSON
- IC59-ETHER-KYO2

Ethernet 10BaseT, 100BaseTX (RJ45)

- IC73-FAST-KYO-TX
- IC77-FAST-EPSON-TX

Token Ring STP, UTP (IBM Type1/2, Type3)

- IC60-TOKEN-KYO

More information about InterCon:

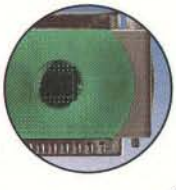
SEH Computertechnik GmbH
Südring 11 D-33647 Bielefeld, Germany
Phone: +49 / 521 / 94226-0
Fax: +49 / 521 / 94226-99
Internet: **http:// www.seh.de**
E-Mail: **info@seh.de**

SEH Computertechnik GmbH

Microsoft is a registered trademark and Microsoft Internet Explorer is a trademark of Microsoft.

▸ Don't forget to lock your software before you leave.

Illegal software use costs software developers over $13 billion each year. Hardlock helps you solve this problem by guaranteeing licensed use of your products. More and more developers like you are relying upon the Hardlock Protection System to increase their sales and profits. And Hardlock now offers you unmatched ease-of-use, with exciting new features.



Hardlock Twin.
State-of-the-art protection for demanding applications.

Hardlock E-Y-E.
The worldwide standard for quality software protection.

www.hardlock.com

▸ HL Crypt. Leading-edge security, adapted to your needs.

Our automatic protection system secures your application and any related data, in a matter of minutes. No access to the source code is necessary, making HL Crypt an ideal solution for software resellers. And HL Crypt's new advanced security features include support for 32-bit environments.

▸ Hardlock Bistro. The quick and easy way to secure your software.

The new Hardlock GUI, with Drag'n'Drop functionality, makes it easier than ever for you to use our wide range of protection tools, quickly and efficiently.

The Hardlock Software Security System. State-of-the-art security – and easy to use.

▸ Order your Hardlock Developer's Kit today! Contact your local representative.

If your country is not listed, please call us directly:
Aladdin Knowledge Systems Germany Tel: (49) 89 8942210 Email: info@aladdin.de

Argentina
HT-MACH Sistemas Electronicas
T (54) 1 795-8011

Australia
Software Protection Systems
T (61) 3 9544-4455

Benelux
Aladdin Software Security Benelux
T (31) 24 648-8444

Brazil
HT-MACH Sistemas Electronicas
T (55) 21 257-0314

Chile
Datasoft
T (56) 2 246-7443

Croatia
G & G Electronic
T (385) 1 335398

Czech Republic
EvroCAD
T (42) 02 6610-7505

Finland
FAST Finland
T (358) 9 5495-0500

France
Aladdin France
T (33) 1 413 770 30

Greece
FAST Hellas
T (30) 1 600-4662

Hong-Kong
Xitec Technology
T (852) 2301-2340

Hungary
Szki Recognita
T (36) 1 201-8925

Israel
Aladdin Knowledge Systems
T (972) 3 636 2222

Italy
TECHNE Security
T (39) 59 415608

Korea
AC & P
T (82) 2 736-4406

Mexico
Sisoft
T (52) 91 800 55283

Philippines
Integrity Software
T (63) 2 831-3112

Spain & Portugal
FAST Iberica
T (34) 1 754-1212

Taiwan
New Solar Systems Group
T (886) 2 633-5586

United Kingdom
Aladdin Knowledge Systems UK
T (44) 1753 622-266

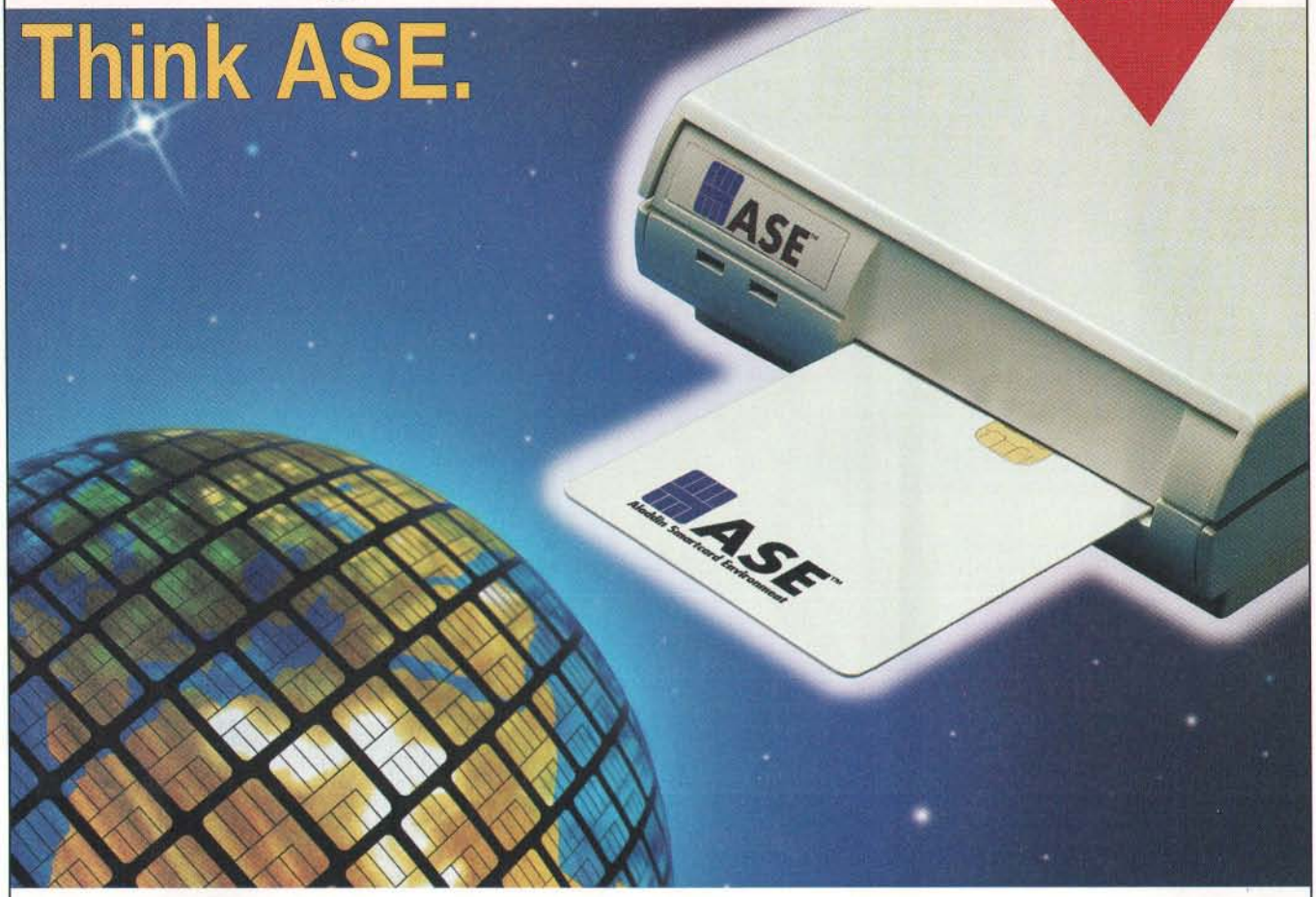
U.S.A.
Aladdin Knowledge Systems
T (1) 800 562-2543

ALADDIN
KNOWLEDGE SYSTEMS LTD

Thinking Smart Cards?

New! ASE-II™ - Next Generation ASE

Think ASE.



In the new world of smart cards, ASE is all you need to develop and deploy smart card applications.

▶ **ASE*Drive Pro*™** – The most versatile smart card drive

Well connected: Interface to both PC internal and external, serial and parallel ports

Secure: Second card slot or SIM socket for authentication and security

Fast: PC-drive communication speed up to 115 Kbps. Cards support up to 76.8Kbps

On time: Real Time Clock for e-commerce or digital signature

Knows its cards: Multi card protocol T=0;T=1;T=14; Memory: I²C, XI²C, 2/3 bus

Configurable: ASE*Drive* internal firmware downloadable from the PC

Ready for the future: PC/SC Ready

▶ **ASE*Soft*™** – The software library for smart cards

Versatile: Supports most smart card types

Powerful: Interoperability with high level API or transmission level API

O/S savvy: Supports Windows NT, 95

▶ **ASE*Cards*™** – A wide selection of smart cards
Memory, protected memory, CPU and Cryptographic cards support

▶ **ASE*Crypto**** – The cryptographic library
RSA; DES; TripleDES support and more. Compatible with Microsoft PC/SC cryptographic tools

▶ **ASE-FES™** – Sample smart card-based file encryption system

To order your ASE developers kit visit our web site today – www.aks.com!

North America	**Aladdin Knowledge Systems Inc.** 800 562-2543, 847 808-0300, Fax: 847 808-0313, Email: ase.sales@us.aks.com
Int'l Office	**Aladdin Knowledge Systems Ltd.** +972 3 636-2222, Fax: +972 3 537-5796, Email: ase.sales@aks.com
Germany	**Aladdin Germany** +49 89 89 42 21-65, Fax: +49 89 89-42-21-40, Email: info@fast-ag.de
UK	**Aladdin Knowledge Systems UK Ltd.** +44 1753 622 266, Fax: +44 1753 622 262, Email: sales@aldn.co.uk
Japan	**Aladdin Japan Co., Ltd.** +81 426 60-7191, Fax: +81 426 60-7194, Email: sales@aladdin.co.jp
France	**Aladdin France SA** +33 1 41-37-70-30, Fax: +33 1 41-37-70-39, Email: info@aladdin.fr
Benelux	**Aladdin Software Security Benelux B.V.** +31 24 648-8444, Fax: +31 24 645-1981, Email: aladdin@worldaccess.nl
Russia	**Aladdin Software Security R.D. Ltd.** +7 095 923-0588, Fax: +7 095 928-6781, Email: ase@aladdin.ru

1-800-562-2543
www.aks.com
ALADDIN®
KNOWLEDGE SYSTEMS LTD

© Aladdin Knowledge Systems 1997 (10/97) ASE is a trademark of Aladdin Knowledge Systems. *Subject to export license.

Two early Deschutes systems are fast and affordable, but upgradability is limited. ***By Michelle Campanale***

Shooting the Rapids at 333 MHz

With a computer's life cycle now lasting about two years at best, it almost seems silly to buy the most expensive computer on the market. Enter the 333-MHz Pentium II. Systems with this newest Intel processor (code-named Deschutes) are bargain-priced to make way for next-generation machines with a 100-MHz system bus and Intel's BX chip set. (See "Deschutes: Pentium II Breakout," page 24.)

The 333-MHz speed offers an obvious performance advantage over systems with 300-MHz/Slot 1 CPUs (see the graphs on page 42). Unfortunately, the 333-MHz Deschutes represents the end of the line for the PII/Slot 1 upgrade path, according to Intel.

We tested two of the first available 333-MHz Pentium II-based systems: Hewlett-Packard's Vectra VL, an entry-level PC for corporate environments, and Compaq's Deskpro 6000, targeted at corporate power users. Performance testing with BYTEmark, Bapco's Sysmark 4.0 for Windows NT, and Van Horn's Photoshop V.4 real-world application benchmarks shows that these 333-MHz systems yield an 11 percent performance gain, across the board, over their 300-MHz counterparts. Performance differences between the two systems are negligible, which is no surprise given their common 333-MHz processor.

HP VECTRA VL

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

COMPAQ DESKPRO 6000

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

HP Vectra VL

For the most part, I like the HP's choice of components. They include a 6.4-GB Ultra ATA hard disk, a 24X Max rewritable CD-ROM drive that uses HP's SureStore rewritable technology, an embedded Sound Blaster Pro-compatible sound chip, and internal speakers. For graphics, HP offers a Matrox Millennium II PCI card with 8 MB of Window RAM. All this fits on two ISA slots, two PCI slots, and two shared slots. The Vectra starts with 32 MB of RAM, which seems silly considering it comes loaded with NT 4.0. (At our request, HP accommodated us with 64 megs.) Of course, you can purchase the system with as much as 384 MB of SDRAM. Note, though, that the system does not support error-correction code (ECC) memory. One surprise is that the machine does not come with a network interface card (NIC). HP considers this a custom-order option. This is an interesting choice for a line that is marketed at corporate buyers, but a decision likely influenced by a need to keep the price down. And, at an estimated street price of $2450 without a monitor, the price is right.

I really like the design of the HP. Its HPX motherboard holds all its components. Like the ATX design, the HPX

TECH FOCUS: PROCESSORS

What's New About Deschutes

Deschutes does not offer any architectural changes to the PCs it sits in. Both the 333-MHz Compaq and the 333-MHz HP we tested have an L2 cache that runs at half the core speed. However, some Pentium IIs have error-correction code (ECC) cache and some don't. HP says its Vectra VL's 333-MHz processor does not support ECC cache memory, whereas the Compaq Deskpro 6000's does. What's really at the core of the Deschutes 333-MHz processor is simply its manufacturing. It is made with a .25-micron process, while its predecessors were made with a .35-micron process. As a result, the whole chip is physically smaller, and the time it takes for the signal to travel even the longest distance (i.e., the signal path) is now shorter. According to our series of BYTEmark and other tests, shrinking that signal by 10 percent gives 333-MHz machines an 11 percent performance advantage over 300-MHz machines based on the .35-micron process.

PHOTOGRAPHS: STEVEN GREENBERG © 1998

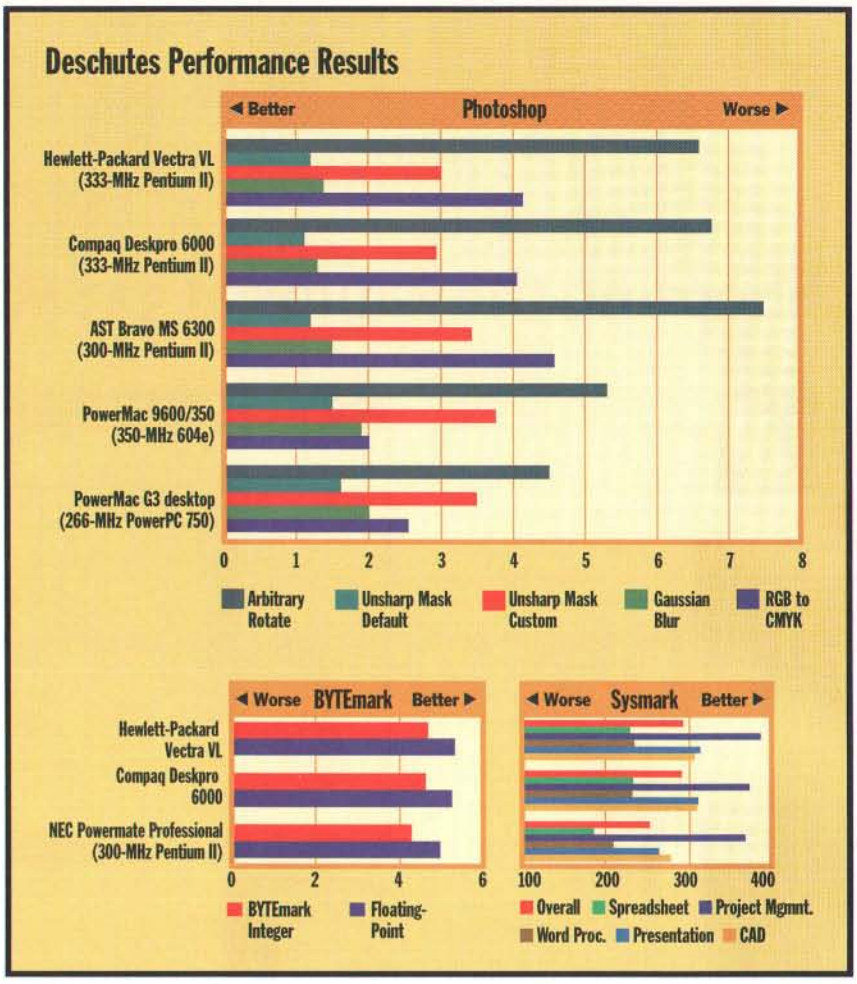
design allowed me to lift a single lever to remove the whole motherboard. I was able to get to the motherboard without taking out the riser card. Additionally, I could slide the entire case right off once I pulled out two levers located on the front face of the chassis. I appreciate the fact that the inside is uncluttered. I could quickly access processor and RAM by lifting the power supply up and over the top of the machine. Like the Compaq, the HP has two fans, one of which pulls air in. An air duct funnels heat away from the components and out through another fan. I disconnected one of the fans and ran the machine for a week without noticing any thermal interference. Unlike other vendors (including Compaq), HP supports OS/2 and Windows 3.11, in addition to Windows 95/98 and NT, on the Vectra VL line.

Compaq Deskpro 6000

Compaq markets its Deskpro 6000 at the power user in a networked computing environment, so its 4.3-GB Ultra SCSI hard drive and 64 MB of ECC SDRAM are appropriate choices. The system is configured similarly, but is by no means identical, to the HP Vectra VL. The Compaq has two universal serial bus (USB) ports, a Matrox Millennium II 4-MB Accelerated Graphics Port (AGP) board, integrated Netelligent 10/100 Ethernet controller, integrated 16-bit sound chip, and internal 56K modem. Its 24X CD-ROM drive is read-only, unlike the HP's. Its three PCI slots, one ISA full-length slot, two ISA half-length slots, and one shared (PCI/ISA) slot are contained within the LPX motherboard, which is a Compaq design.

Compaq's processor cartridge is mounted differently on the motherboard. The model 6000 has a modified Slot 1 that is 90 degrees to the motherboard, allowing the processor cartridge to be parallel to the motherboard. The layout of the PCI slots makes it a little difficult to add PCI modules. Additionally, I noticed that the AGP card slot is buried behind the PCI slot connector board. I had to dismantle a lot of things to get at the AGP slot.

The memory slots are also hard to reach without removing the motherboard—a difficult process in itself. But to Compaq's credit, its design attempts to put as many things as possible into a small footprint.



Best Bang for Your Buck

There will always be a faster processor or a newer technology over the horizon. With the onslaught of a new Intel processor every few months, you've got to wonder, "Should I buy now or wait six months until the next technology comes out?" If you really need to buy a fully configured system now, and want a system that will last for a couple of years, you can't go wrong with either of these machines from two of the top vendors.

However, the HP Vectra VL's price and performance, large hard disk, rewritable 24X CD-ROM drive, and ease of access to internal parts, make it an excellent choice. If you plan on doubling your workstation as a server, you might want to go with the Compaq since it uses ECC SDRAM. However, the Deskpro is $479 more than the Vectra, offers the same performance, and adds only a NIC and a 56K modem. Also, it has a smaller SCSI drive, and its 24X CD-ROM drive is not rewritable. B

PRODUCT INFORMATION

Hewlett-Packard Vectra VL
$2450
(6.4-GB Ultra ATA hard disk, 64 MB of RAM, 24X CDRW-ROM, Matrox Millennium II graphics card, 16-bit sound, internal speakers, floppy drive, NT 4.0)
Hewlett-Packard Corp.
Palo Alto, CA
800-752-0900
650-857-1501
http://www.hp.com/vectra
Enter HotBYTEs No. 1072.

Compaq Deskpro 6000
$2929
(4.3-GB Ultra SCSI hard drive, 64 MB of SDRAM, Matrox Millennium II AGP graphics board, integrated Netelligent 10/100 Ethernet controller, integrated 16-bit sound, two USB ports, three PCI slots, one ISA full slot, two ISA half slots, one shared PCI/ISA slot, one AGP slot, 56K PCI modem card, floppy drive, NT 4.0)
Compaq Computer
Houston, TX
800-345-1518
281-514-1740
http://www.compaq.com
Enter HotBYTEs No. 1073.

at http://www.byte.com/hotbytes/

Michelle Campanale is a BYTE technical editor for hardware reviews. You can reach her at **michelle@dev5.byte.com**. *Lab director Al Gallant assisted with testing.*

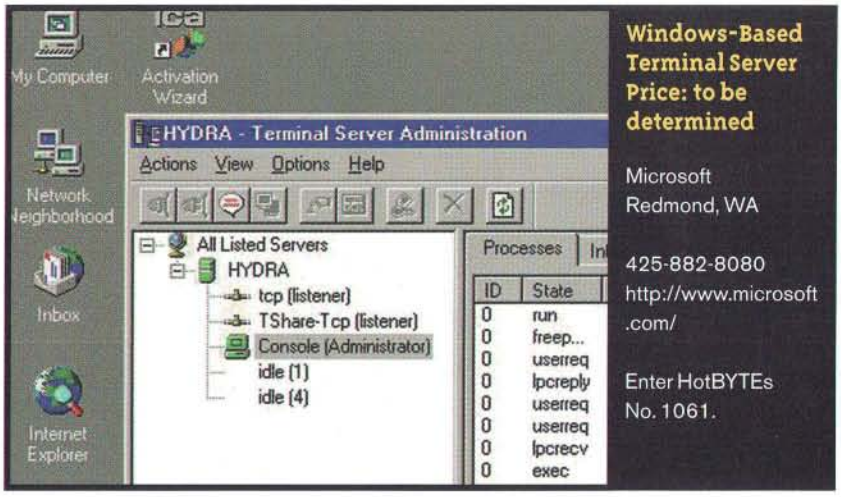
Hello, 1970s! We're headed back to the future with Windows-based terminals. ***By Morgan Stern***

Terminal Compromises

With its forthcoming Windows-Based Terminal Server (WBTS), Microsoft is either making a giant leap forward or taking a step back in time. Or both. Terminal Server is based on technology from Citrix Systems, whose WinFrame multiuser application server is based on Windows NT. (See below for Citrix's new pICAsso add-on to WBTS.)

Like WinFrame, Terminal Server lets multiple users access Windows applications running on a centralized NT server. Users need only a small software client or a low-cost, dedicated terminal. Sound familiar, Mr. Mainframe Manager?

With WBTS, organizations can focus support, development, and maintenance efforts on a single server farm, without worrying about constant hardware upgrades, software distribution, and configuration management. Each server supports multiple simultaneous users, each appearing to control his or her own desktop. System managers can also incorporate bits of Microsoft's Zero Administration Initiative, such as restricting user access to specified applications. For many organizations, this could significantly reduce help-desk calls and support costs.



Windows-Based Terminal Server
Price: to be determined

Microsoft
Redmond, WA

425-882-8080
http://www.microsoft.com/

Enter HotBYTEs No. 1061.

The Windows-Based Terminal Server administration utility provides control over terminal sessions.

Terminal Server needs serious hardware and memory: 32 MB of RAM plus 8 MB (or more) per user. We'll likely see quad-CPU servers with 1 GB of RAM to support 50 to 100 people.

Terminal Server is optimized for 32-bit applications. Using DOS and 16-bit apps is memory-intensive and will degrade performance. Also, a single server failure will affect many users. Many organizations will need pICAsso's Load Balancing option to provide continuous availability for mission-critical applications.

RATINGS	
TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

We tested beta copies of WBTS and pICAsso and had clients hooked to the server 5 minutes after installation. We used PC clients plus Wyse and Neoware terminals. Both packages showed impressive performance and should serve many organizations handily. Indeed, for many NT administrators, the challenge will not be choosing to implement WBTS but finally admitting that the mainframe folks had a good thing going! B

Morgan Stern is a network consultant in Boston and the coauthor of NT Enterprise Network Design *(Sybex, 1997). He can be reached at* **morganst@world.std.com.**

pICAsso Paints Mac and Unix Windows

Citrix extends terminal support to DOS, Mac, and Unix clients through pICAsso, a WBTS companion based on the company's patented Intelligent Console Architecture (ICA) protocol. ICA has already been implemented in a number of network terminals, a Web browser snap-in, and a stand-alone client. With pICAsso, clients can access the Windows terminal server via the T-Share protocol, while other platforms use ICA for client-to-server communications. pICAsso also has an optional Load Balancing module and enhanced support for client-side resources, letting users print to a local printer.

RATINGS	
TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★

PRODUCT INFORMATION

pICAsso (Price: to be determined)
Citrix Systems, Inc.
Fort Lauderdale, FL
954-267-3000, http://www.citrix.com/
Enter HotBYTEs No. 1060.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

NetWare 5's native TCP/IP and Java support fill in the missing links in Novell's Internet strategy. ***By James E. Gaskin***

NetWare Enters the Nineties

Think of NetWare as a 1970s VW Beetle—solid, reliable, and everywhere. Now, with NetWare 5, Novell plans to retool that Beetle into a Porsche. Novell is making it easier than ever to use TCP/IP for all network client communications, and Java support explodes all over this current beta version, which is code-named Moab.

The graphical splash screen on the server may shock those who, familiar with NetWare, expect an aging character-based menu system in shades of blue, yellow, and white. Even more radical is the X Server Graphical Console. Clicking on the Novell button on the task bar opens a menu offering Applets, Background, and Exit GUI. Applets offers standard Unix tidbits like a clock and a wireframe box, written in Java. The server includes dozens more Java sample applets along with necessary libraries for programmers.

Developers, increasingly put off by Novell's clunky NetWare loadable module (NLM) application server, have flocked to Windows NT. Moab's inclusion of NT management tools acknowledges NT as the platform of choice for most network management. Novell says it wants to entice developers back to NetWare by coating all server functions with Java software interfaces to simplify development. Moab isn't there yet, but Java should keep the most painful NLM problems out of sight by the time NetWare 5 ships.

Traditional NetWare clients should run reliably with NetWare 5. My test server worked for weeks without a hiccup while plugged into an existing NetWare directory tree. Though Windows 95 couldn't see the new server, older DOS and Windows 3.1 clients could, as could the NetWare NT client software.

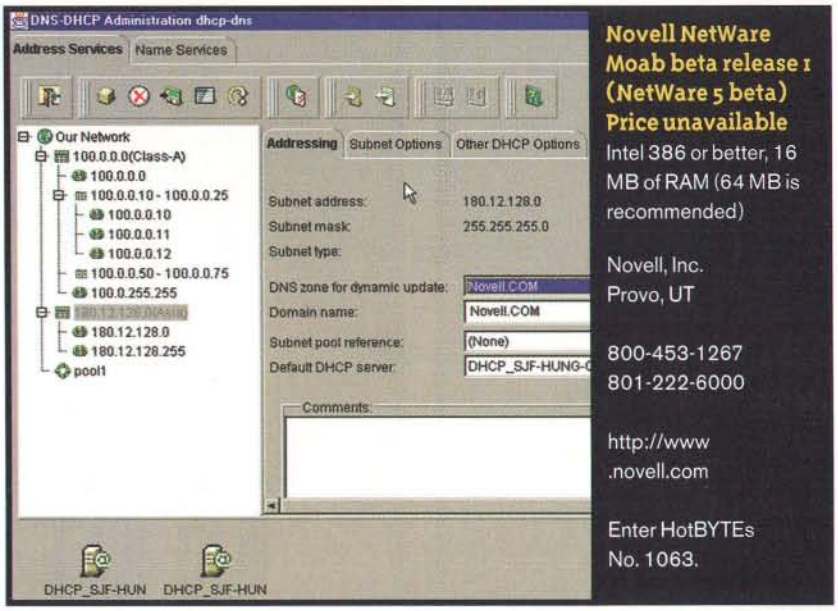
You can now choose TCP/IP, IPX, or a mixture during installation, but the mixture won't work with this release. Windows 3.1 complained at the lack of IPX when starting, but connections to the server worked well without IPX, including the Windows File Manager, which happily displayed server directories.

Using TCP/IP for NetWare client to NetWare server communications also means that client browsers work over the internal network without needing the Novell IPX to TCP/IP gateway. Suddenly,

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

NetWare is an intranet server system supporting every TCP/IP client on the network, just like the press release promised. When the final release (expected this summer) supports both TCP/IP and IPX clients, Novell's NetWare will be back as the world's most connectable network. B

James E. Gaskin writes books about NetWare and the Internet, including his latest, Intranet-Ware BorderManager *(Sybex, 1997). You can reach him at* **james@gaskin.com.**



Novell NetWare Moab beta release 1 (NetWare 5 beta)
Price unavailable
Intel 386 or better, 16 MB of RAM (64 MB is recommended)

Novell, Inc.
Provo, UT

800-453-1267
801-222-6000

http://www.novell.com

Enter HotBYTEs No. 1063.

Novell's new Java-based graphical interface to NetWare 5 may surprise some, but it will simplify network management tasks.

TECH FOCUS

Migrating to IP

Novell's IPX was based on the best protocol available at the time of Xerox Network Services (XNS), before TCP/IP's acceptance made IP the network protocol of choice. Untying IPX from the NetWare server software came first, starting when NW 3.0 was rewritten in C in 1989. Client software started the move with the NETX software in NW 3.0 on through the virtual loadable module (VLM) clients of early NW 4.x, and separated totally with the latest Client32 versions released with this beta version.

Sun's Software Suite is a scalable set of OS and application components for hand-held and embedded devices. ***By Tom Whittaker***

An OS for Information Appliances

As consumer demand for information access continues to rise, technology companies face the challenge of developing operating systems that are ideally suited for information appliances (IAs). These are consumer devices that perform only a few targeted tasks and are controlled by a simple touchscreen interface or push buttons on the device's enclosure. IAs can receive information from networked or nonnetworked sources: via modems, telephone lines, or CD-ROMs (as shown at right). IAs must use very little memory and processing power in order to be affordable so that average consumers will adopt them.

Recognizing that the bills of materials for IAs must be as low as possible, the Consumer Technologies Group (formerly Diba, Inc.) at Sun Microsystems built its software from the ground up. They did this because pared-down PC systems often include power-hungry interface features and components that are unnecessary in efficient IA designs. As a result, Sun's IA software—called the Sun Information Appliance Suite—is compact, open, and flexible. The software can be adapted to run almost any consumer electronics devices, such as Internet-enabled TVs, Internet phones, vertical-application hardware, and more.

Open and Modular Platform

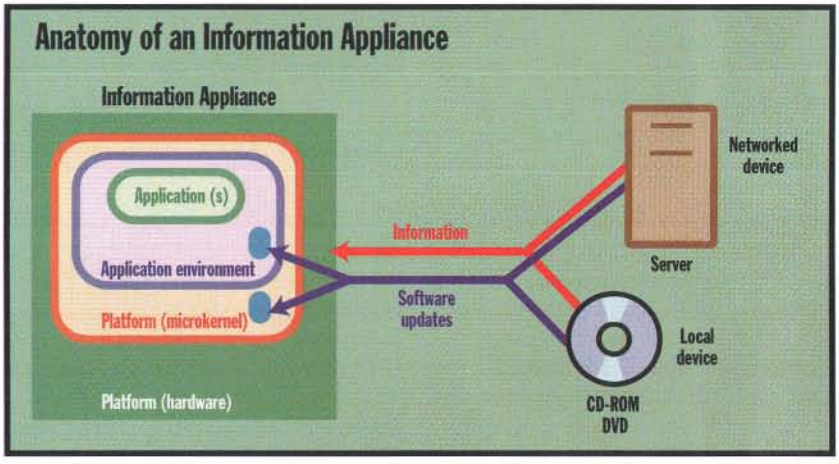
The Sun IA Suite consists of four levels, as shown in "The Sun Suite Levels" (see next page). Each level uses an open API that allows the system to be extensible and portable. As a result, the IA Suite is processor- and microkernel-independent, which gives manufacturers a vast range of implementation choices. The first and lowest level is the platform implementation level. It consists of both hardware and software components. The hardware components include a microprocessor, memory, and peripherals. The software components include a microkernel, device drivers, and networking protocol stacks.

Sun's platform implementation is based on an open architecture that includes no proprietary transport protocols. This allows developers to port the software to any real-time microprocessor or microkernel, and it enables cross-platform development. Sun has already ported the software to a number of processors, including the Mitsubishi M32RD, the Motorola PowerPC and 680x0, and the NEC V830 and V831.

The platform implementation's portable microkernel is 80 KB and is multithreaded, priority-based, and preemptive. It supports semaphores, message queues, mutexes (mutual exclusion flags), multiple timers, and events. It is written mostly in C, with small portions—the context-switching and interrupt services—written in assembly language. Note that the Sun IA Suite can run on any microkernel, and the suite has been ported to a number of OS kernels, including pSOS, Linux, Solaris, Windows NT, OS-9, and ITRON.

The operating system-specific (OSS) interface handles application services that are specific to the microkernel. The OSS lets developers create low-level services for one microkernel and then move them to other microkernels quickly and easily. To do this, developers first port the OSS to the target microkernel, and then load the recompiled and linked application onto the IA for execution.

This level also includes Sun Service Link, a mechanism that allows software to be upgraded easily and quickly via an Ethernet or modem connection to a Web site. Through a point-to-point protocol or the TCP/IP stack, upgrades and maintenance are performed transparently, without user interaction.



An information appliance is a consumer device that's optimized to perform only several specific tasks.

Foundation to Build On

The next level is the Sun application foundation. It can be considered a "virtual"

OS that provides the basic software for building IA applications. Developers write directly to these APIs to create customized programs for new IAs or other appliances—such as DVD players or fax systems—that don't require an extensive GUI-based application. If less customization is required, developers can take advantage of the architecture's application modules and applications in the upper levels.

The application foundation consists of graphics and font libraries, an opaque device library (ODL), and a system library. All are written in C. The graphics library provides developers with a set of software functions for drawing and displaying graphics, fonts, and images. It supports various displays, such as VGA, LCD, and TV, and includes 2-D drawing modules, imaging and rasterizing functions, screen and color controls, and JPEG and GIF libraries. Developers can configure the graphics library to support any display type at any time.

The font library formats fonts for a wide variety of possible displays, from black-and-white to color, from NTSC to LCD. It provides anti-aliased characters for TV display and a variety of LCD and monitor types.

The ODL uses an API that has one interface yet supports many device types. This simplifies application programming and lets developers easily substitute devices. It also enables IA applications to be hardware-independent, since these APIs make the details of manipulating a device's hardware "opaque" to the application. For example, the Sun Browser application can receive data from a modem, CD-ROM, or server: It uses the same ODL calls no matter the data delivery mechanism.

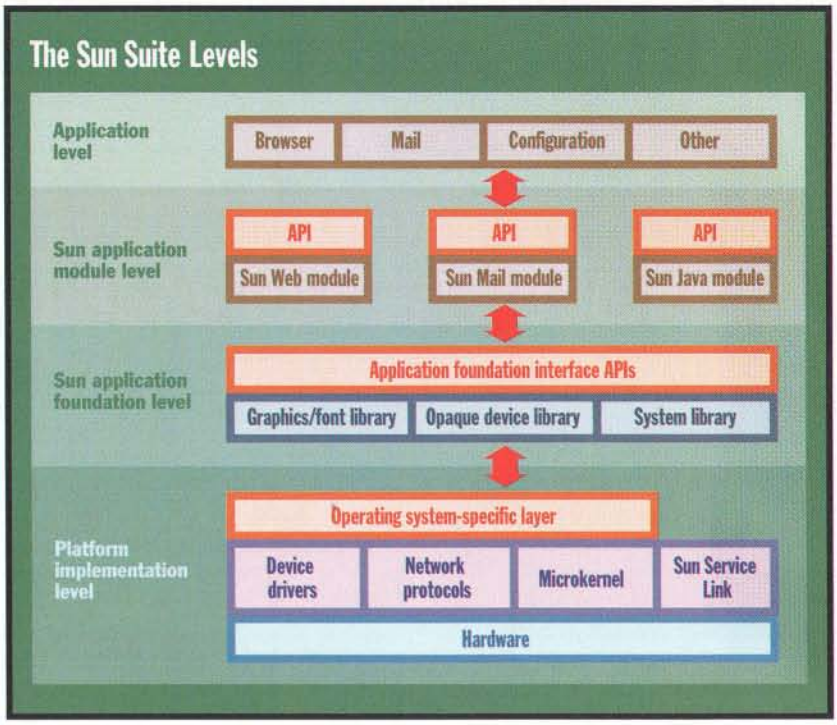
The system library acts as the intermediary between an application and the microkernel and helps make the applications OS-independent. It does this through a "generic" API that provides access to basic system services, such as memory management, error handling, thread and state management, messaging, and real-time clock/time interface. The most important of these services is memory management, since many IAs have limited physical memory with no virtual paging.

Modules and Applications

The third level consists of a set of Sun application modules that helps developers quickly create IA applications. Each module contains core pieces of software, written in C, that are common to many different appliance applications. Each module works with different displays.

The Web module provides designers with a toolkit for creating URLs and making HTTP requests. This module also parses HTML content and returns HTML marks to the application programs in a tree format, allowing designers to easily reformat the content. The Sun Mail Module allows designers to include multimedia e-mail in applications. It supports Internet mail messages using SMTP, POP3, and IMAP4. Multimedia type and multiport document handling is included, as well as a Multipurpose Internet Mail Extensions (MIME) engine for encoding and decoding character translation. Other modules provide basic services such as GUI widgets, telephony, real-time audio, real-time video, and Java.

The end-user applications are at the highest level of the Sun Information Appliance Suite. They implement the targeted task that the end user operates to obtain information. Sun has created several complete turnkey applications that developers can customize to bring IAs to market quickly. Some of these applications include Sun Browser, Sun Mail, Sun Configuration, Sun Telephony, and Sun Address Book. These easily customized applications enable developers to modify the underlying graphics and personality of the base application to create unique versions for specific products; for example, a developer might customize the Address Book application to operate on a cellular phone.



Each level further abstracts the IA's OS and hardware; applications can be quickly ported or customized for new devices.

OS for the Future

As consumer demand for easy access to information grows, it will further promote changes to information-access devices. OSes for these devices must be flexible, open, and modular, while offering high-level, easily customized applications. Sun has created such an OS, which can be licensed today in its complete form or as individual components. For more information, visit the Sun site at http://www.sun.com and request a copy of the Sun technology white paper entitled "Technical Architecture for the Information Age." B

Tom Whittaker is chief scientist for the Consumer Group at Sun Microsystems. You can reach him in care of **editors@byte.com.**

This object-oriented RPC architecture is built on standards, yet it is extensible. ***By Paul Clip***

DCOM: Microsoft Enhances DCE

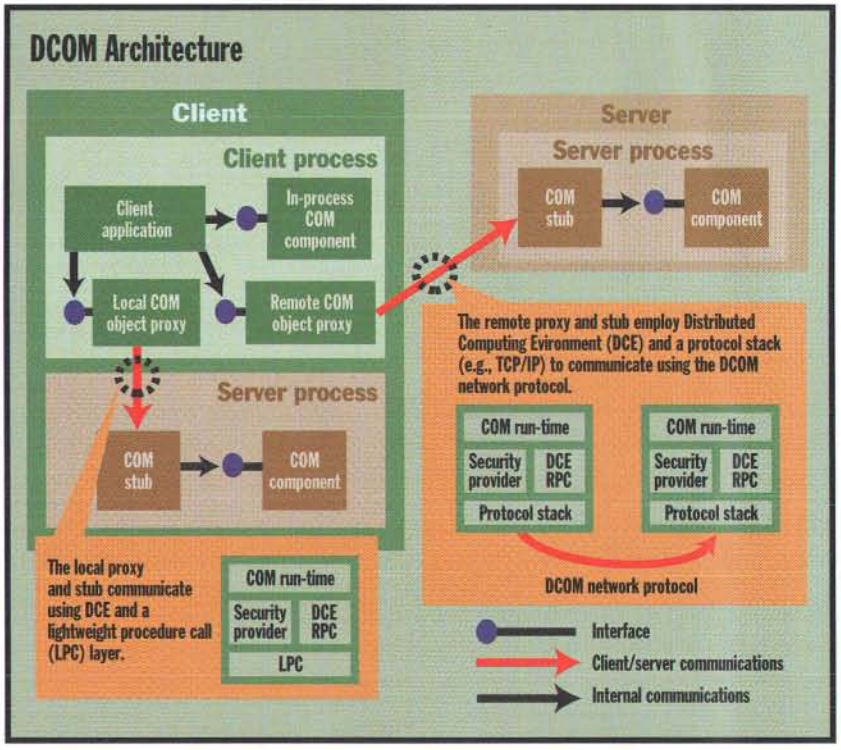
Unlike Java's remote method invocation (RMI) or CORBA's Internet Inter-Orb Protocol (IIOP), the Distributed Component Object Model was not made from scratch. Rather, Microsoft built DCOM, introduced in Windows NT, upon an existing standard called the Distributed Computing Environment. DCE, created by heavyweights including IBM, HP, Sun, and DEC as a cross-platform environment, provides a common set of services such as remote procedure calls (RPCs), naming, thread management, and security.

DCOM is also called Object RPC (ORPC) to indicate that it is an object-oriented extension of DCE RPC. In this article we will use the term DCOM more generally to refer to the distributed version of Microsoft's Component Object Model (COM), which defines how components interact with client applications. As such, DCOM builds on COM's strengths to bring features such as location independence, language neutrality, garbage collection, and component versioning to distributed environments.

A component exports one or more interfaces. Each interface is essentially a group of methods that the component implements and clients may call. The figure "DCOM Architecture" shows the different invocation models. If a component is in-process, a client invokes its methods directly, as it would invoke functions in a library. Otherwise, the client uses a proxy to call remote components, independent of whether they reside on the same machine or not. Each proxy has a stub counterpart on the server side that it communicates with to invoke a component's methods.

DCE RPC

DCE RPC is a complex RPC mechanism with a wealth of capabilities. For data marshaling, DCE provides the network data representation (NDR), which supports the encoding of arbitrary data types. In the realm of security, DCE RPC offers various levels of authentication, authorization, and message integrity. DCE can be configured to use the host computer's security mechanisms, hence the security-transport protocols; three are common to both. Each PDU consists of a header containing control information (e.g., the PDU's type and length), optionally followed by a body and an authentication verifier, depending on the PDU type and whether authentication is in use.



DCOM lets clients transparently invoke a procedure locally or remotely.

provider layer shown in the figure. DCE also supports a number of protocols, both connectionless (CL) and connection-oriented (CO). Perhaps most important, DCE RPC has been in use for a number of years and has proven its worth.

DCE RPC defines 20 different messages (called *protocol data units*, or PDUs) that are exchanged between client and server. Some are specific to CL or CO

The figure "DCE RPC Messages" (see the next page) provides a high-level overview of the different PDUs, indicating their origin and grouping them by function. For brevity, only the connectionless PDUs are shown in their entirety. The most important messages are shared between CO and CL protocols: Request, Response, and Fault. A client uses a Request to invoke a remote pro-

cedure call; the server uses Response and Fault to return results or to return an error, respectively.

In CL mode, clients send an Ack to acknowledge receipt of a Response PDU. Servers send a Reject PDU to indicate that a Request is rejected, and why. A Ping is sent by a client to inquire about an outstanding Request. The server may reply either with a Working PDU that tells the client it is processing the Request or with a Nocall message that indicates it has not received the Request or that some of its fragments have been lost.

A client can cancel an RPC by sending a Cancel PDU, to which the server replies with a Cancel_Ack. When a message is too long to be sent in its entirety, both parties may send the Fack PDU to acknowledge receipt of a fragment of a Request or a Response.

DCOM and Performance

Although DCOM uses DCE as its RPC mechanism by default, much of DCOM can be overridden and customized. For instance, an application might not use NDR and instead handle marshaling on its own. Or it might not use DCE at all and provide its own RPC mechanism. This can be very useful to wrap legacy system services inside a COM component.

To reduce method invocation time, DCOM provides ways for components to copy their state to the client side, thereby eliminating network communication overhead on calls. Objects can even handle some operations on the client side while forwarding others to the server for further processing. For example, a component could cache a subset of a SQL query result, then incrementally fetch more rows if and when required.

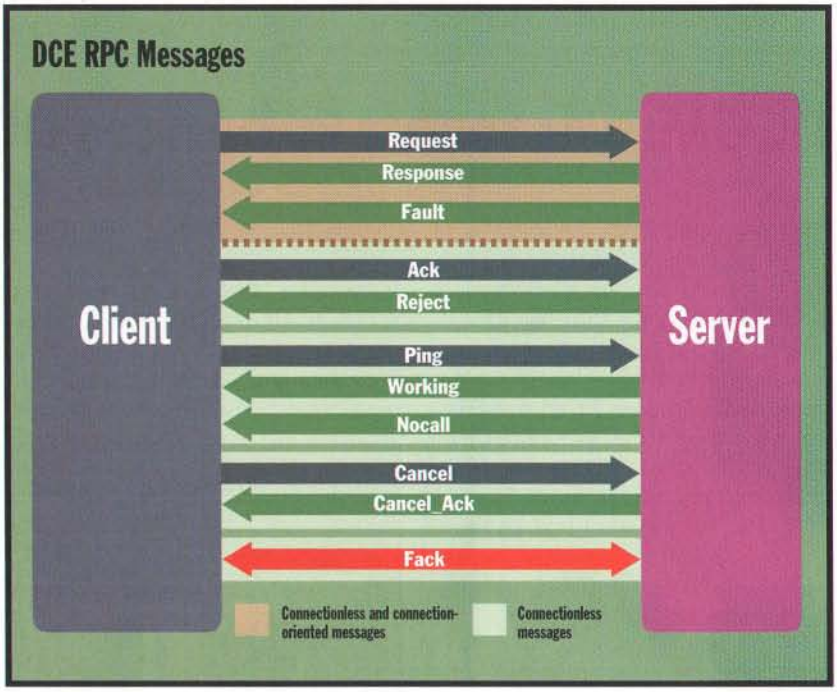
As with other distributed systems, garbage collection is a thorny issue: When does a server garbage-collect one of its objects, and how can it be sure no more clients are using it? DCOM solves this problem in two ways: reference counting and pinging.

Every time a new reference (i.e., an interface) to a component is obtained, the client calls DCOM's `AddRef` method to tell the server to increment the reference count for that object. When the client no longer needs the interface, it calls the `Release` method, which causes the server to decrement the reference count. A component with a count of zero can then be garbage-collected.

To improve performance by eliminating unnecessary network activity, DCOM combines multiple `AddRef` calls to increment the reference counts of different interfaces by arbitrary amounts. `Release` calls are also combined. In addition, a proxy defers releasing an object's interfaces until all local references to those interfaces have been released.

No reference-counting mechanism is impervious to clients crashing and not releasing their interfaces properly. To address this situation, DCOM uses a sophisticated pinging technique (unrelated to DCE's Ping PDU) that not only sends pings on a computer-to-computer basis (instead of object-to-object) but also employs delta pinging to combine objects into sets. This strategy reduces the size of each ping message. For example, 10 clients running on the same machine using the same server component results in only one ping—containing references to the 10 clients—not 10 individual pings. Delta pinging further groups the 10 references into a set to eliminate the need to include 10 client references at every ping.

DCE RPC specifies that RPCs be handled in arbitrary threads. COM provides support for both single-threaded and multithreaded invocation models. In the former, COM serializes RPCs to free the programmer from dealing with concurrency issues, possibly resulting in suboptimal performance. The multithreaded model allows various threads to invoke an object's methods simultaneously. This requires the programmer to use synchronization primitives to serialize access to shared data, but it improves call throughput.



Messages are exchanged through protocol data units (PDUs) that contain control, data, and security information.

More to DCOM

Although DCOM is still predominantly a Windows standard, Microsoft's partners are busy porting it to other platforms, such as Sun's Solaris and IBM's OS/390. DCOM's DCE foundations greatly facilitate this work since DCE has been widely ported. In an effort to move DCOM into the Java space, Microsoft's Java virtual machine incorporates the necessary capabilities for Java classes to access or become COM components.

Microsoft will be extending DCE RPC in NT 5.0 to enable clients to make asynchronous RPC calls. Further out, Microsoft's announced COM+ will substantially enhance COM by making it easier to use and more powerful. ■

*Paul Clip (**paul@clip.org**) is an IT consultant at Sapient Corporation's San Francisco office. He focuses on object and Web technologies.*

www.byte.com

The Mips processor architecture offers you ways to extend computing power for custom applications. ***By Reynaldo Archide***

A Flexible CPU for Digital Cameras

The Mips microprocessor architecture offers a number of major designer benefits, among them, flexibility. You can use its flexible architecture to partially customize the CPU core. Also, four coprocessor interfaces let you accelerate the core's computing power via tightly coupled, special-purpose processors.

These capabilities were especially valuable in the design of LSI Logic's CW4003 RISC processor. It represents the CPU in a system on a chip, the DCAM-101, that's the heart of LSI's digital camera (DCAM).

The CW4003's core is a derivative of the Mips R3000 architecture, with two additions: a multiplier-arithmetic bolt-on (MABO) unit and the use of the coprocessor 2 (CP2) interface to build a high-speed pixel processor. The DCAM-101 provides interfaces that support various peripherals, further simplifying a DCAM's overall design and reducing its cost.

DCAM Close-Up

The DCAM-101 consists of modules that implement the CW4003 processor core, the peripheral controllers, and a host of device interfaces. (See the figure "Digital Camera Processor.")

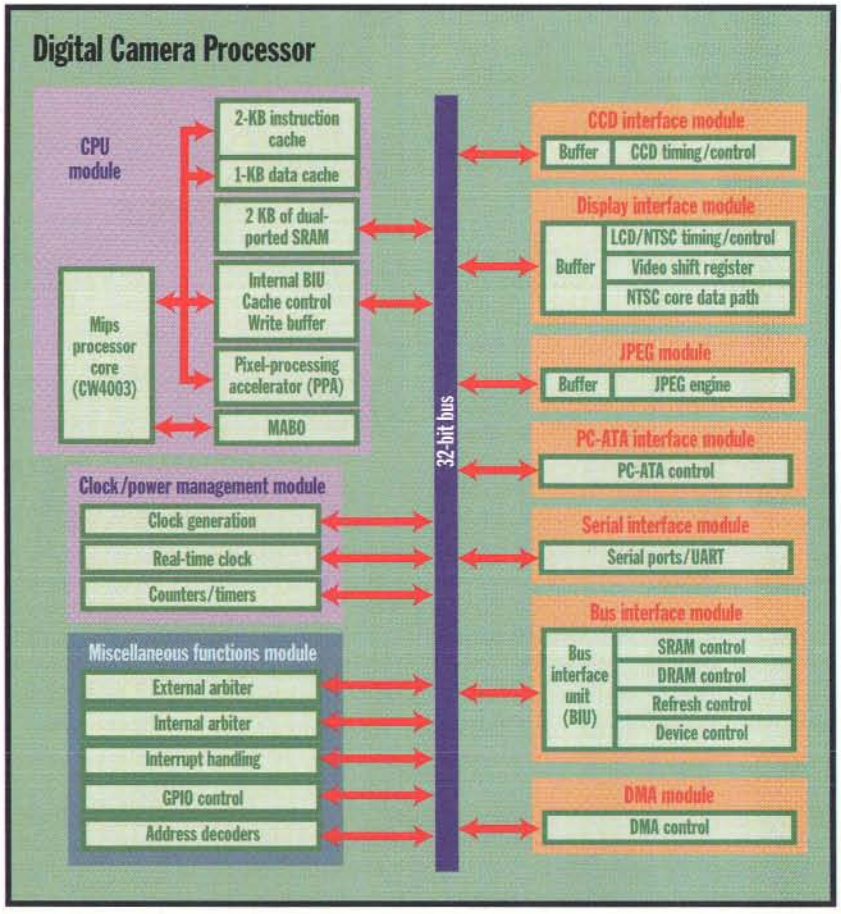
Some of the modules provide interfaces to the major DCAM subsystems: a serial interface for connections to desktop computers, a PC-ATA flash-memory interface for image storage, a charge-coupled device (CCD) interface for image capture, a JPEG compression/decompression unit, and an NTSC/PAL unit. This last module implements a 4-2-2 encoder input format and contains 10-bit programmable-video D/A converters (DACs) that generate S- and composite-video output for use on TV.

Other modules supply the signals and control for system parts: a bus interface unit (BIU) that handles external static RAM (SRAM) and DRAM, a DMA controller that moves data throughout the chip, and power management circuitry.

The CPU module contains the 32-bit CW4003 processor, the internal BIU, a 2-KB instruction cache, a 1-KB data cache, 2 KB of dual-ported SRAM, a pixel-processing accelerator (PPA), and the MABO. The processor core essentially controls the flow of data through the hardware-processing stages. It operates between 0 and 54 MHz, performs any load scheduling, and runs a subset of the Mips-II instruction set.

A new wait-for-interrupt (WAITI) instruction halts the core and keeps it from executing instructions until an interrupt is observed. This wait state dramatically reduces power consumption.

The MABO unit adds fast integer multiply instructions to the CPU core. When the core detects a multiply instruction, it is forwarded to the MABO, where it is



The Mips R3000 architecture lets the CW4003 core support special coprocessors and a slew of device interfaces.

executed. The MABO instructions include six multiply instructions that perform operations on unsigned and two's complement 32-bit numbers.

Besides multiply instructions, the MABO also executes the Mips divide and divide-unsigned instructions. All MABO instructions are pipelined, and its pipeline runs independently from the processor core pipeline.

The SRAM implements a direct-mapped architecture, where one memory address corresponds to one location in the cache. Because the SRAM is dual-ported, this lets the CW4003 and the DMA controller access it simultaneously.

Digital Camera Overview

The figure "Digital Camera System" shows how the system on a chip works. It connects to a CCD daughtercard that contains the DCAM lens, CCD array, and A/D converters (ADCs). The DCAM lens focuses an image onto the CCD, which is an array of photosensitive diodes. Each photodiode has a green, red, or blue filter, which causes it to respond to different ranges of the optical spectrum. The CCD and its associated circuitry construct a digital representation of the image.

When you snap a picture, the CW4003 reads out the light level of each pixel into SRAM. It uses the PPA to produce a 24-bit-per-pixel color image. You can display this image on an LCD or TV. You can also JPEG-compress it for storage in nonvolatile memory. The image shown on the LCD is stored in flash memory as soon as you take a picture.

The DCAM chip provides the DCAM with three modes of operation: Finder, Capture, and Display. Finder mode is used when you scan the environment. While you pan the DCAM, it processes the data captured by the CCD into an RGB format and presents it on the LCD.

As soon as you take a photo, the DCAM goes into Capture mode. The chip's operation and data flow are similar to those of Finder mode. However, the final image is JPEG-formatted, compressed, and transferred to flash memory. Display mode lets you view stored pictures. The DCAM retrieves an image from flash memory, uses the JPEG engine to decompress it, and maps it to the LCD or TV.

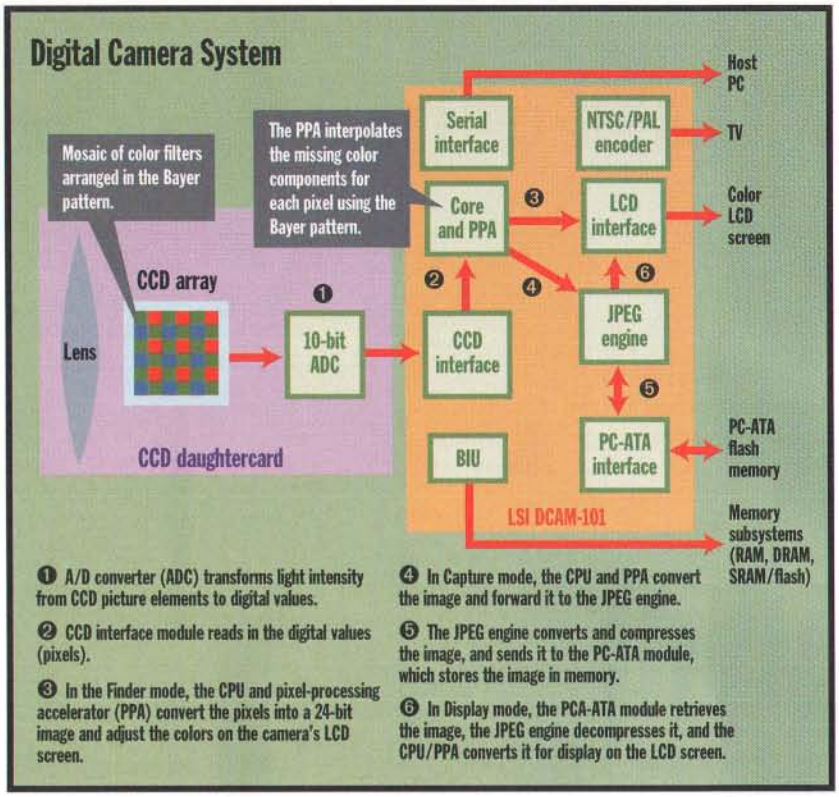
Making Picture Perfect

Acquiring an image with good color fidelity requires substantial processing of CCD image data. You begin by moving a CCD data block into SRAM, where it is transferred to the PPA. The CPU, PPA, and MABO (which executes single-cycle multiply/accumulate [MAC] instructions) run software algorithms that process the pixel data.

The PPA performs the heavy-duty processing that converts the CCD data into either an appropriate RGB image (for display on the DCAM's screen) or YCbCr image (for JPEG compression). The PPA first expects the CCD image to use a mosaic of colored dots arranged in the Bayer-pattern format. As shown in the figure, it consists of alternating green-red and blue-green lines.

The pixel color-processing operation is segmented into preprocessing and postprocessing stages. In the preprocessing stage, the PPA interpolates green pixel values by subtracting the green value from the corresponding red and blue values. In the postprocessing stage, it filters the red and blue values, and adds the green value back in.

The PPA then does the color-space conversion that compensates for the different types of displays and edge enhancement. The pixel-processing algorithms that were developed for this DCAM application are implemented via five dedicated hardware instructions (e.g., color plane separation and pixel subsampling) that significantly accelerate the interpolation process.



The DCAM-101 implements most of the camera's functions and controls on a single chip.

The One-Chip Solution

The simple act of taking a picture on a DCAM creates a lot of data traffic and requires great processing power—enough to perform complex color-space conversions and data compression/decompression at near real-time rates. Through the Mips architecture, LSI was able to add custom coprocessors and custom instructions to accomplish this task. The DCAM-101 does all this, while reducing the price of a cost-sensitive consumer product by providing glueless support to various DCAM subsystems. B

Reynaldo Archide is a project engineering manager for microprocessor cores at LSI Logic. You can contact him via the Web page at **http://www.lsilogic.com.**

Introducing
The McGraw-Hill Companies'
Newest Partner

BYTE

Germany

Distributed in
Germany, Austria and Switzerland

circulation 100,000

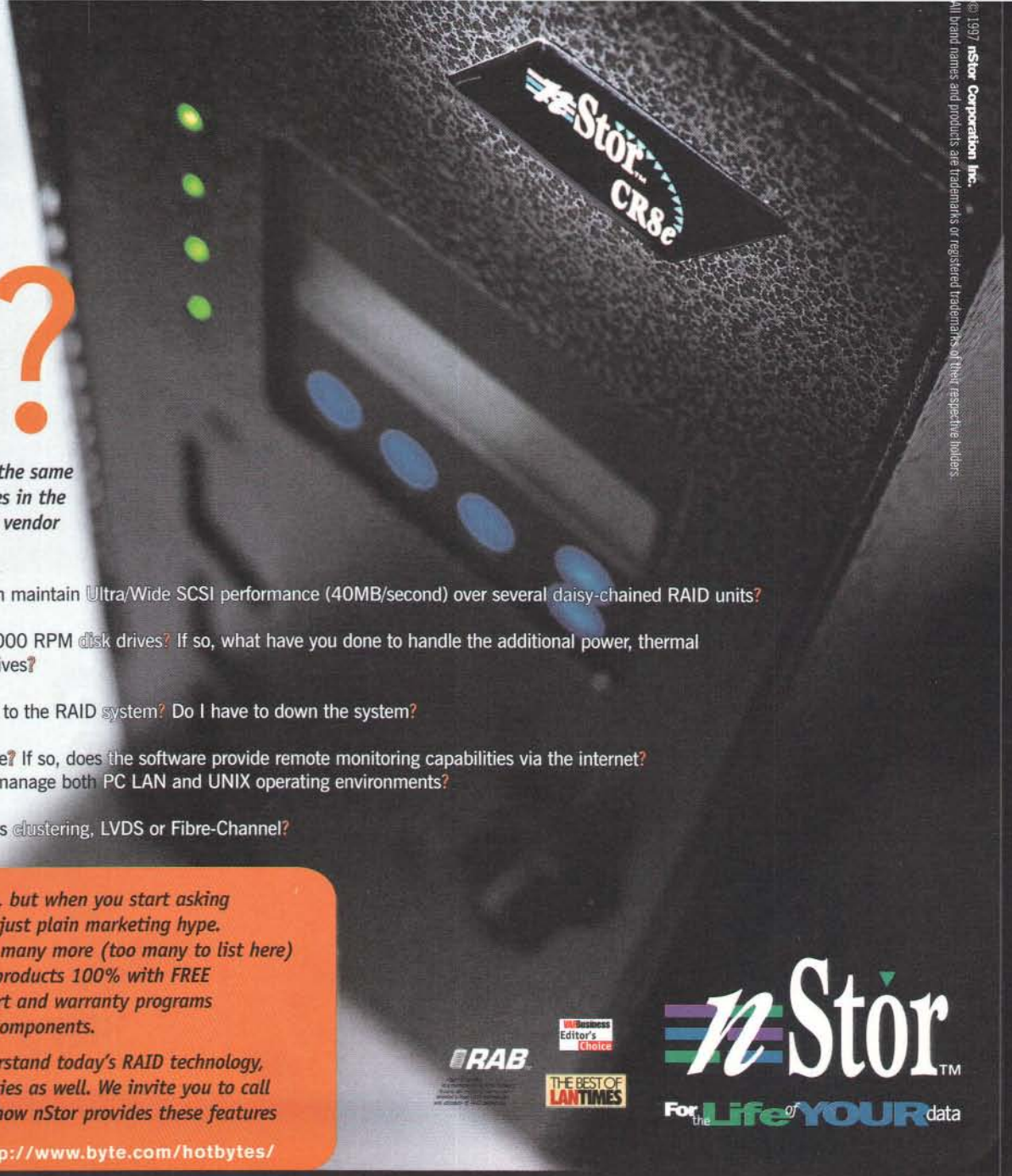
Launching in March 1998

For information, please contact:

Frank-Martin Binder, Editor in Chief
Tel: +49 89 456 16123
Fax: +49 89 456 16300
e-mail: fbi@byte.awi.de

THINKING ABOUT

RAID *for your* MISSION-CRITICAL data?



© 1997 nStor Corporation Inc.
All brand names and products are trademarks or registered trademarks of their respective holders.

Then THINK about this: many RAID storage vendors list the same features, but not all companies implement those features in the same way. Before you purchase a RAID system, ask each vendor how their products provide the following features...

- Given Ultra SCSI's cable length restrictions, can the system maintain Ultra/Wide SCSI performance (40MB/second) over several daisy-chained RAID units?
- Does the system support the new higher performance 10,000 RPM disk drives? If so, what have you done to handle the additional power, thermal and vibration requirements of these higher performance drives?
- What if I need to reconfigure or add more storage capacity to the RAID system? Do I have to down the system?
- Does the system include free storage management software? If so, does the software provide remote monitoring capabilities via the internet? Does it include a common GUI interface to configure and manage both PC LAN and UNIX operating environments?
- Can this system be upgraded to future technologies such as clustering, LVDS or Fibre-Channel?

Lots of RAID storage companies claim fantastic features, but when you start asking for details about these features, you will find many are just plain marketing hype. Not at nStor. We incorporate all the above features and many more (too many to list here) into our RAID technology. And, nStor stands behind its products 100% with FREE pre- and post-sales support, unmatched technical support and warranty programs such as "spare-in-the-air" cross shipments of hot swap components.

We're confident you'll see that not only does nStor understand today's RAID technology, we're building RAID systems to support future technologies as well. We invite you to call our nStor account managers at 800.724.3511 and ask how nStor provides these features and many more.

Enter HotBYTEs No. 119 at http://www.byte.com/hotbytes/

RAB

VAR Business Editor's Choice

THE BEST OF LANTIMES

nStor™

For the Life of YOUR data

nStor Corporation Inc.: 450 Technology Park, Lake Mary, FL 32746 · **Telephone** 407.829.3500 · **Fax** 407.829.3555 · **U.S. Sales** - 800.724.3511 · **Technical Support** - 800.724.3511 · **E-mail** - sales@nstor.com · **Web Site** - http://www.nstor.com · **European Sales** - +44(0)1234 213571

You can use Java's run-time error checking to improve a program's performance. **By David Orchard**

Better Performance with Exceptions in Java

An *exception* is a special condition, usually an error, that interrupts the normal flow of program execution. You're probably all too familiar with processor exceptions, where a desktop computer's CPU detects a situation—such as a reference to a nonexistent memory address—that it can't recover from. But a few programming languages provide the means of detecting and responding to certain type of exceptions.

Why support exception handling when most function calls return error codes? Exceptions are an improvement over the use of return codes in two key ways. First, they provide a formal mechanism that generates an error condition and passes it to an error handler. Second, since they separate error handling from the regular flow of program operation, they let you consolidate all the handlers within one section of a program rather than strewing them about.

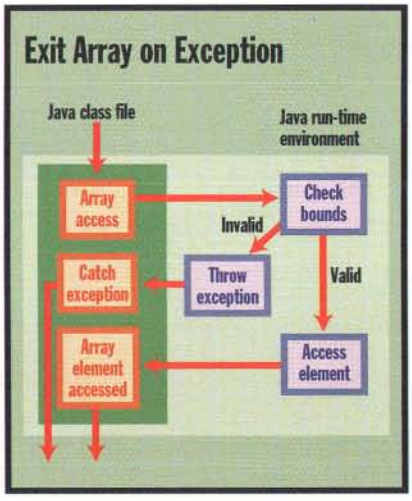
Java's exception mechanism provides a powerful means for asynchronously transferring program control outside of a method. In this article, I'll show how to use this feature to improve the performance of certain operations.

Taking Exception

In Java, you create an exception with the `throw` keyword. As the word *throw* implies, once an error occurs, the program's flow typically jumps to another method far, far away from the original one. The `throw` keyword creates an exception object, which contains information that's passed to a `catch` block.

The `catch` keyword specifies the code sections that execute when a particular exception happens. Put another way, the `catch` block contains the exception handlers. Since `throw` creates an object, you can throw distinct exception classes in response to different error conditions. Only the method whose class matches the exception object's type executes in the `catch` block.

If the method containing the `throw` statement doesn't have a `catch` block, Java throws the exception to the calling method. If this method doesn't have an exception handler for the exception type, it's thrown to its calling method. This act of passing the exception up the call stack ensures that, at some point, a method deals with the problem.



Java's built-in boundary checking lets you easily exit an array.

In situations where you want to limit the `throw` to handlers within the method that caused the exception, you use the `try` keyword. For example, a custom I/O method might require special handlers that deal with unusual conditions. This `try` block contains the methods that create—either accidentally or by design—exceptions, followed immediately by its `catch` block of handlers.

The `finally` keyword completes the description of exception handling in Java. A `finally` block specifies a section of code that always executes before the method returns. This includes any `return` statements within and without `catch` blocks and `throw` statements. Collectively, these code sections are known as the `try/catch/finally` statements, which are often abbreviated as the `try/catch` statements. A code fragment representing all these keywords and blocks is shown in the text box "Code Gallery" on page 54.

Run-Time Exceptions

While the Java compiler tries to catch as many errors as it can, most errors don't show up uninvited until a program runs. Java has many built-in exception classes that handle a variety of errors. The base class is `RuntimeException`, which handles most exceptions created by programming errors. Some of the exception types that `RuntimeException` handles include sanity checks on array and vector accesses, casting a class to the wrong type, and reading and writing from streams.

If your application does many of the preceding operations repeatedly and performance is a concern, consider replacing the error-checking code with an exception handler. Before firing up that code editor, you must first determine the cost of a `try/catch` block without the `catch` being executed. This shows you whether the cost of using such blocks can actually boost performance.

Compare the following two code samples, both of which use a loop.

Loop with error checking:

```
for( int i = 0; i < 2000; i++ )
  {
  message = String.valueOf(i);
  }
```

Loop with exception handling:

```
for( int i = 0; i < 2000; i++ )
{
try
  {
```

continued

```
  message = String.valueOf(i);
  }
catch (Exception e)
  {
   System.out.println("Should
     not be printed");
  }
}
```

Both of these loops yield almost identical benchmark times using JDK 1.1.3 on a system that has a 133-MHz Pentium and 48 MB of RAM, running Windows NT 4.0. (Since Java implementations are constantly updated, your mileage may vary.) This means that the `try/catch` clause takes time only when the `catch` statement executes. It's this feature that leads to the significant performance improvement of replacing array bounds-checking with a `try/catch` clause.

I also tried this code using Visual J++ 1.1 under NT. The results were completely unexpected: The Jview benchmarks resulted in a 15 percent performance degradation when using `try/catch` statements. Apparently, `try/catch` statements under Microsoft's virtual machine (VM) exact a substantial overhead. But I'll press on, discussing the use of JDK 1.1.3, assuming that not all Java developers are targeting the Microsoft VM.

Improvement by Exception

The traditional way to access an entire array is through a `for` loop. By slightly altering the `for` loop syntax, you can improve code legibility and performance all at once.

My test case was an array operation on integers. Both code fragments are shown in the text box at right. First I looped through a 2-million-element array, setting the values to the index. (The initial `for` loop code is in the section "Loop with bounds check.") For comparison, I deleted the bounds check and encapsulated the `for` loop in a `try/catch` statement, as shown in the section "Loop using exception." The second implementation yields a staggering 30 percent to 40 percent speed improvement using JDK 1.1.3 on the same hardware configuration.

Why is this so? I let Java's `java.lang.ArrayIndexOutOfBoundsException` handler break the thread of execution out of the loop while eliminating any bounds-checking code and its overhead. The figure on page 53 shows the execution flow. This example can boost the performance of applications that are processing large data arrays, such as algorithms that display or modify text or images.

But using exceptions is not a panacea. When I tried the improved code with the Microsoft VM, it yielded a 30 percent to 40 percent speed reduction. Obviously, the Microsoft VM handles exceptions differently than Sun's VM. While using exceptions can dramatically improve a program's performance for certain operations, it does so only with specific implementations. The situation is exacerbated by the fact that users can be running a medley of OSes, Java VMs, and browsers.

If this statement appears to make the task hopeless, remember that as good as Java is as a client-side language, it's a fabulous server-side language. For server applications, you can be certain of the Java VM that's running and tune your code accordingly. If you're using Sun's JDK, you should be able to achieve significant improvement in array-access performance by replacing bounds checking with exception handling. ■

David Orchard is a technical architect at the IBM development center in Vancouver, British Columbia, Canada. You can contact him at **orchard@pacificspirit.com**.

Code Gallery

Sample try/catch/finally statements

```
Public class test
{
    public void aMethod()
    {
        try
        {
            // Normal method calls and processing
        }
        catch( myException me)
        {
            // Catch myException and handle condition
        }
        catch (Exception E)
        {
            // Catch all Exceptions except myException
        }
        finally
        {
            // code that must always be executed
        }
    }
}
```

Loop with bounds check

```
int anInt[] = new int[2000000];
for( int i = 0; i < anInt.length; i++ ) // Limit test in "for"
  {
  anInt[i] = i;
  }
```

Loop using exception

```
int anInt[] = new int[2000000];

  try {
    for( int i = 0;; i++ ) //No limit test here
    {
    anInt[i] = i;
    }
  }
  catch (ArrayIndexOutOfBoundsException e)
  { } // When we get here, we're out of the loop
```


www.byte.com

Based on object-oriented standards, this language supports complex data types and distributed computing. ***By Daniel Evans***

The OQL Standard Emerges

We are now witnessing the advent of the next major wave in client/server computing. This change is the result of the convergence of distributed computing, object technology, and the Internet.

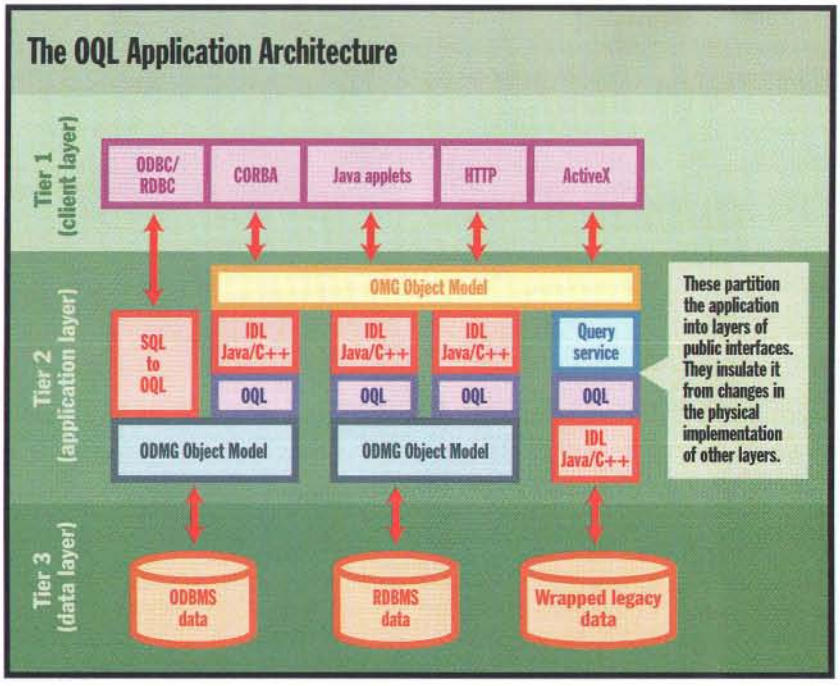
At the heart of this new paradigm is a simple yet powerful query language designed for managing data objects, called Object Query Language (OQL). Defined by the Object Database Management Group (ODMG) industry consortium, OQL is a superset of the SQL-92 query language. OQL is designed to leverage existing skills and knowledge while integrating support for industry-standard object models, such as the Object Management Group's (OMG) object model.

Two Forces

Two important market forces are driving the emergence of OQL as the standard for executing queries on objects: the need to manage complex data and its relationships, and the move to distributed object applications. I'll examine each of these forces in turn.

The first springs from the changing nature of data itself. While the quantity of data stored in relational databases has grown rapidly over the past decade, the explosion of complex data within corporate application environments is even more remarkable. Much of this data exhibits complex structure, such as spatial and multidimensional data, project plans, compound documents, and CAD designs. The growth of the Internet has only intensified the use of such data, since organizations deploy multimedia content on it at an ever-increasing pace.

To manage these data types, the ODMG OQL environment offers a number of object-oriented features. Using standard programming interfaces, you define new types of data objects and their related built-in operations (i.e., methods). You can invoke these operations within standard queries and execute them under the control of a query optimizer.



Using a variety of protocols, OQL provides transparent management of complex data objects.

The second force is the result of traditional two-tiered client/server application architectures giving way to *n*-tiered architectures. This move toward distributed object applications is related to a more fundamental shift toward object-oriented computing in all stages of the application life cycle.

Object Roots

To meet the needs of distributed object applications, the ODMG OQL environment embraces the best technologies available within the industry, including the following:

- **An Object Model (OM)**, based on the OMG object model.
- **An Object Definition Language (ODL)**, based on the OMG Interface Definition Language (IDL).
- **An Object Query Language (OQL)**, based on the SQL-92 query dialect.
- **An Object Manipulation Language (OML)**, defined by bindings to object-oriented (OO) languages, such as Java, C++, and Smalltalk.

By building on the existing OMG object model and IDL, developers can stay within a single object model for object programming, object messaging, and object management. The ODMG OM and ODL provide a consistent object model and definition language for mapping object schemata to data in other environments, such as object DBMSes, relational DBMSes, and object request brokers (ORBs), as shown in the figure "The OQL

Application Architecture" on page 55.

Since OQL builds on the SQL-92 query standard, it lets developers leverage existing programming skills. Because OQL uses the OMG object model, the integration with OO programming languages and ORBs is seamless, allowing OQL statements to be invoked within these environments. Conversely, OQL can directly invoke operations within other object environments.

Because OQL is based on OO programming language standards, developers can implement direct and transparent database interfaces for applications. This enables client- and server-side application logic to be implemented in a portable and nonproprietary manner instead of using a DBMS-specific stored-procedure language or database API.

A current trend indicates that vendors will standardize on ODMG as a single and consistent environment for accessing relational and object data alike. A recent example includes JavaSoft's announcement to support the ODMG standard as the common object-relational mapping above the Java Database Connectivity (JDBC) API layer. A few vendors are also providing Java and C++ developer tools that transparently support relational and object database systems.

Ways to Connect

There are at least three ways in which OQL can be accessed from client applications. The first is to use ODBC or JDBC client connections to converse with OQL. A client application connects with the server using ODBC and sends SQL commands, which are directly mapped to OQL commands. On the server, a dispatcher process receives the connection request and transfers it to the first available OQL server process, which provides service directly to the client until it disconnects.

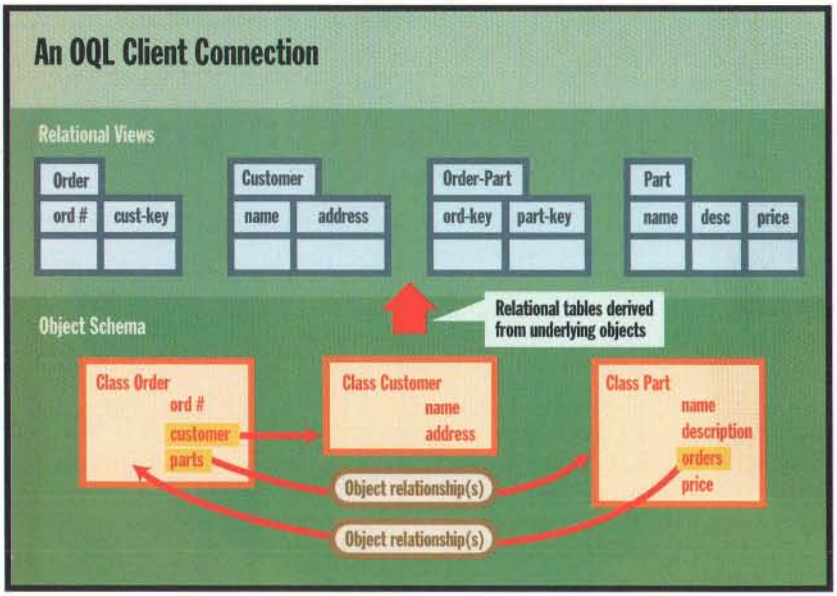
Relations are derived from objects by the generation of a tabular view of object schemata. Queries and update statements are processed against this view and translated into equivalent OQL query operations on native object data. Each class is mapped into a relation; atomic attributes of the class definition are mapped into the corresponding SQL atomic columns; and attributes referring to objects and one-to-one, one-to-many, and many-to-many relationships are translated into foreign keys, as shown in the figure "An OQL Client Connection" below.

The second way to access OQL is by using Common Object Request Broker Architecture (CORBA) application connections. A new generation of object-oriented tools leverages the capabilities of CORBA, giving clients a way to communicate easily with server-side resources using object messaging. Object messaging offers more flexibility to scale or partition distributed resources, making it the communications mechanism of choice for building distributed applications.

In this technique, OQL is defined as the query language within a CORBA service called Object Query Service (OQS). This is a set of interfaces that map directly to OQL queries. Using OQS, an application executes standard OQL queries against collections of CORBA objects, independently of their physical location and storage mechanism.

Non-object-oriented data and legacy applications can be integrated using an implementation approach called "wrappers," which hide legacy data behind CORBA IDL object interfaces. These so-called wrapped objects then participate in distributed applications the same way that other CORBA objects do, using messaging and OQL-based query services.

The third means of accessing OQL is through HTTP/HTML Web connections. A rising percentage of new applications requires Internet-based data access. Dynamic Web interfaces can be combined with object messaging and OQL queries to provide high-performance transactional applications. Queries are requested using an OQL command embedded in URL links, which are sent to a gateway OQL process via an HTTP server. The query results are dynamically generated as HTML pages. The resulting pages can contain references to other objects (i.e., composite objects) that in turn contain other embedded OQL query links as URL addresses.



Through OQL, relational views are derived from underlying object classes.

The Object Advantage

Application portability is a central concern within the design of any application system. Rather than inventing proprietary extensions to SQL to define and manipulate objects, OQL complies with industry standards defined by SQL, the OMG, and the ODMG. Support for ODBC, CORBA, and HTTP connections provides plug-and-play access for productivity, query, and development tools.

OQL's fundamental principle of deriving relations from objects, rather than extending relations to provide partial object support, yields significant advantages for users in performance, scalability, capabilities, and adaptability to change. B

Daniel Evans (Denver, CO) is product manager for object technologies at Unidata. He can be reached at **daniele@unidata.com**.

Taking Command Just Got Easier

NEW! On Screen Management

The only KVM switch with the power and flexibility to manage the most complex server rooms just got better. Now, not only can you manage hundreds - even thousands - of servers from a single location, but with our new On Screen Management, it's easier than ever. Pop-up menus make it simple to name, configure and select your attached servers on the fly.

Multiple Users

For growing multiuser systems, the AutoBoot Commander 4xP allows up to four users simultaneous access to any attached computer. Add even more users with our expansion options, all with independent access to every computer.

Easy Expansion for your Growing System

Designed for expansion, the 4xP allows you to easily add computers and users as your installation grows. Combine that with our extension capability, and you can locate computers and users as far as 300 feet away from the 4xP unit!

Multiple Platforms

The 4xP is designed from the ground up to support multiple platforms: Mix and match PC, Sun, SGI, HP 9000, Dec Alpha, RS/6000, and Macs -- control them all with a single set of peripherals.

Whether you run a growing data center or the most demanding server room, the 4xP saves you valuable time, space and money. Who would have thought a command performance could be so easy?

CYBEX®

Cybex Computer Products Corporation
4912 Research Drive Huntsville, Alabama 35805 USA
(800) 93CYBEX (29239) • (205) 430-4030 fax
http://www.cybex.com

MICROSOFT WINDOWS NT COMPATIBLE · Yes NetWare · RECOMMENDED Reseller News SPRING COMDEX · BANYAN · LANtastic Compatible

Cybex, the Cybex Logo, AutoBoot, Commander and 4xP are trademarks or registered trademarks of Cybex Computer Products Corporation.PC, Sun, SGI, HP, Dec Alpha, RS/6000, Microsoft, Windows NT, Novel, Netware, Banyan, LANtastic and Mac are trademarks or registered trademarks of their respective manufacturers.

SEE US AT: CeBIT, March 19-25, Hannover, Germany

Enter HotBYTEs No. 104 at http ://www.byte.com/hotbytes/

Weaving a Better Web

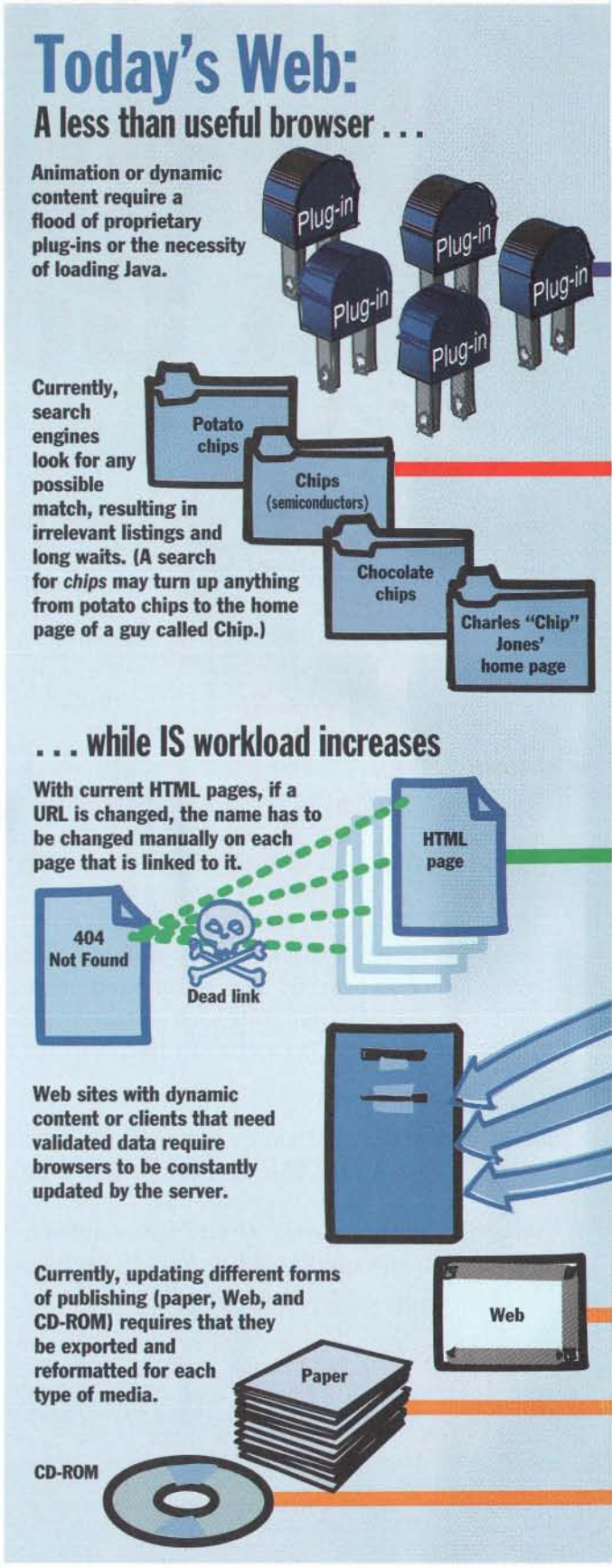
The features that made HTML so popular are causing the Web to fall apart. What's next?

By Scott Mace, Udo Flohr, Rick Dobson, and Tony Graham

We have a love/hate relationship with HTML. We love its easy learning curve and universality, but we hate its easily broken links and limited formatting. We love its simple and compact syntax, but we hate its rigid formatting and inflexibility. To keep what we love and jettison what we hate, we've scripted it, styled it, tabled it, and framed it. Yet, after more face lifts and tummy tucks than an aging Hollywood star, today's HTML is still just HTML. The broken links and formatting problems are just warts and cellulite that won't go away.

It's time to find some new, fresh talent. Although you probably won't discover them in the corner soda shop, a few new stars are about to break onto the scene with names like Extensible Markup Language (XML), cascading style sheets (CSS), and Dynamic HTML (DHTML). Each works on a slightly different set of HTML 3.2's problems: XML on helping organize and find data, CSS on Web page inheritance and presentation, and DHTML on dynamic presentation of Web content. Aided by the recent HTML 4.0 refresh, these new technologies will beat back HTML's legacy of too many dead links, slow searches, and static pages on today's Internet and intranets.

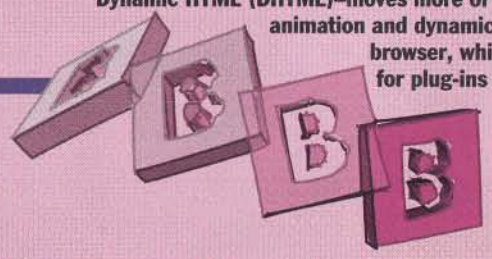
The bad news: At the time of this writing, browsers are between generations, not yet fully ready to embrace these new technologies and standards. But this lag may be just what hatching standards need, giving developers enough time to rethink the way their Web applications should work before a



1999 Web:

Browsers are doing their job better . . .

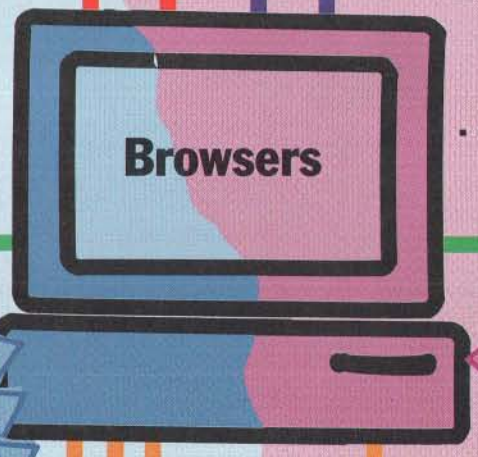
Dynamic content standard–cascading style sheets (CSS) and Dynamic HTML (DHTML)–moves more of the processing for animation and dynamic content to the browser, which reduces the need for plug-ins and will be much quicker. Some clients may use specialized Extensible Markup Language (XML) browsers.



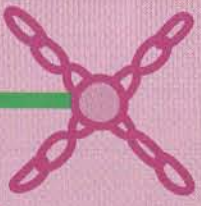
Electronic parts catalog

- Resistors
- Capacitors
- Power Supplies
- Chips (semiconductors)

XML documents contain tags that pertain specifically to the information you are interested in. You're able to navigate to desired data more quickly, and when entire industries agree on sets of tags, search engines don't have to work as hard, and results returned are consistently relevant.



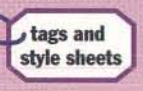
. . . while IS gets some help



With XML, centralized link management can update all instances of a URL by entering the new site just once, because aliases are used.

With XML data schemas (e.g., Resource Description Framework) more data validation will be performed at the browser. Dynamic content, too, will often be browser-based.

All forms of publishing can be done from one master XML document using XML tags and style sheets or Extensible Style Language (XSL).



rewoven Web hits with full force, starting at the end of this year.

Fixes on the Horizon

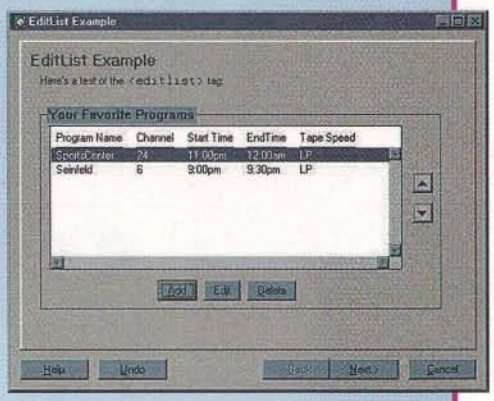
The fact that HTML has problems is hardly news (see "What's Wrong with HTML," below). Netscape, Microsoft, Macromedia, and a host of other companies have invested considerable effort in fixing the problems. We've all seen the results: proprietary HTML extensions, ActiveX controls, Java applets, and plug-ins that try to work around HTML's weaknesses. But these fixes all have problems of their own: They're proprietary, or they require users to install an application extension, or they're not completely supported by all browsers.

This year we'll start to see open, standard fixes to many of HTML's problems. XML, DHTML, style sheets, a document object model, and HTML 4.0 will create standard ways to get around most of the big problems we have with HTML today.

XML is probably the most notable. It's already a standard ratified by the World Wide Web Consortium (W3C), and it rep-

XML in Action

IBM's TaskGuide technology lets technical writers and user-interface developers generate "wizards"–task-oriented dialogs that guide the user, automating the task–without writing code. The XML-based system includes the option to create a recursive document, a wizard that builds another wizard. The following sample script defines a list of TV programs to be recorded; it generates the panel shown here.




```
<sguide>
<title>Editlist Example</title>
<panel name=programs next=done no-
image>
<p>Here's a sample editlist:</p>
<editlist
 name=programs
 type="progName(key), channel
  (format=integer),start, end, speed"
 headers="Program Name,Channel,
  Start Time,End Time, Tape Speed"
 add=addProgram
 edit=editProgram
 delete=deleteProgram
 separator=^A
 ordered
 init="SportsCenter^A31^A11:00pm^
  A12:00am^ALP^ASeinfeld^A6^
  A9:00pm^A 9:30pm^ALP^A"
>Your Favorite Programs
</editlist>
</panel>
...
</sguide>
```

What's Wrong with HTML

The main thing that has made HTML so popular–its simple syntax–is also what has turned it into our biggest headache. Here are the main trouble spots.

Link tracking. Web pages move constantly, and Webmasters can't keep up with the changing URLs. Sure, there are automatic link checkers that will tell you when a link is broken. But the real problem is that HTML does not have the notion of a central link repository.

Syntax checking. HTML obstructs validation because it is not a rigid specification. Rather than checking documents for validity, HTML browsers specifically ignore syntax violations to make the display process more robust.

Extensibility. Because HTML is not extensible, developers cannot create their own tags to reflect their content's semantic relationships. HTML extensions are either proprietary features of the client (which leads to "browser wars" and unreadable documents) or require approval by a committee. They also fatten the specification because they cannot be imported as needed.

Structure. HTML lacks support for structure, such as nested information hierarchies. Documents are relatively flat, which limits searching to full-text searches and makes navigation cumbersome. (Wouldn't it be nice to have not just "Back" and "Forward" buttons but be able to traverse hierarchies with "Up" and "Down"? To automatically create site maps and tables of content? To "collapse" a page, showing just headings?)

Content-awareness. HTML searches have to look at all the content of every page. Therefore, they come up with too many hits. This is because HTML jumbles information and meta-information. Style and logic are hard-coded inside the document. Different views and presentations of the information (e.g., a large-print version) have to be generated by the server. Fancy formatting, such as two-column text, requires hacks by the content developer. (Cascading style sheets are an approach to solve this problem.)

Internationalization. Support for special and international characters (particularly characters with 2 or more bytes and mathematical formulae) is lacking or, at best, inconsistent in HTML. Where provided, it sometimes breaks when changing platforms.

Data interchange. Similarly, HTML does not help with automatic, reliable data interchange. Its markup controls the appearance of a document but does not provide for tagged data fields.

Reuse. HTML makes it difficult to reuse information. For the same data to be published on the Web, printed as a catalog, and maintained in a database, conversion and sometimes manual reformatting is necessary. Worse, this has to be repeated each time the information changes.

Dynamic content. Today's HTML-created pages don't let you refresh the look of a Web page – attributes like its color, font properties, font size, or background images–without loading a new page or invoking Java. Any data stored in Java becomes inaccessible from search engines. For any number of reasons, Java hasn't proven to be a panacea for serving up dynamic Web content.

Object orientation. Developers are hungry to seize the power of object orientation. Today's HTML tags don't map into an object model that would allow any part of a Web page to be treated as an object.

Applications Will Drive XML Acceptance

Once we have newly structured Web documents powered by XML tags, how will we share them and the data contained within them? The unfolding answer appears to be through metadata, as well as a host of industry-specific applications, followed by a surge of e-commerce and Electronic Data Interchange (EDI) efforts.

Resource Description Framework
http://www.w3.org/Metadata/RDF

XML's most important application will probably be the Resource Description Framework (RDF), which will let applications describe to each other not only the data in each document but also new data fields and classes. RDF defines relationships between XML data otherwise left undefined, such as whether the data's position in a document is important.

Netscape's Aurora, a future piece of the Communicator browser, reportedly will use RDF to store bookmarks, mail preferences, and local file and channel identification.

RDF consolidates several earlier, similar metadata syntax efforts, including Web Collections, developed by Microsoft and IBM; Meta Content Framework, developed by Netscape; and XML-Data, developed by Microsoft.

RDF benefits will include better search engines; being able to describe the content and content relationships available at a particular Web site, page, or digital library; facilitation of knowledge sharing and exchange; content rating for child protection and privacy protection; being able to describe collections of pages that represent a single logical document; and being able to specify intellectual property rights of Web pages.

Channel Definition Format
http://pushconcepts.com/microsoft.htm

Microsoft's proposed CDF is an XML application that allows Web publishers to control push technologies. It has been submitted to the World Wide Web Consortium (W3C). Among other things, CDF can be used to specify channels, the information they provide, and their update schedules. The hope is that CDF will help make different push technologies interoperable by doing away with proprietary push technology: Using a CDF-compliant receiver, people could get content from different, previously incompatible kinds of sites (which also would have to comply with CDF, of course).

Open Financial Exchange
http://www.onestandard.com/developers_ofx_specification.html

OFX is a framework for exchanging financial data and instructions among financial institutions and their customers. It allows institutions to connect directly to their customers, without an intermediary. OFX integrates Microsoft's Open Financial Connectivity, Intuit's OpenExchange, and CheckFree's electronic banking and payment protocols.

OFX, which is based on SGML, predates XML and was at the time of this writing incompatible with XML, lacking end tags. Microsoft says OFX will soon be based on XML.

XML/EDI
http://www.geocities.com/WallStreet/Floor/5815

Electronic Data Interchange has for years struggled to take existing paper documents exchanged between companies and automate them. XML just might make EDI fly. XML/EDI is an effort to provide a standard format for XML documents to describe different types of data—for example, loan applications, invoices, or health-care insurance claims, with gateways to existing X12 and EDIFACT systems.

Open Software Description Format
http://www.w3.org/TR/NOTE-OSD.html

Automatic software distribution, like EDI, has been around as a concept for years. OSD, jointly submitted to the W3C by Marimba and Microsoft, is a set of XML tags for describing software packages and their dependencies, and for dealing with software running on multiple platforms.

Chemical Markup Language
http://www.venus.co.uk/omf/cml/doc/tutorial/xml.html

Chemical Markup Language (CML) started out as a Standard Generalized Markup Language (SGML) application but was recently upgraded to XML. It describes molecular and crystal structures, analysis spectra, and other chemical objects.

Mathematical Markup Language
http://www.w3.org/TR/WD-math/

MathML is an XML application for describing mathematical expression structure and content. It would properly display mathematical characters and equations within browsers for the first time since the Web was invented.

resents the largest departure for people used to writing standard HTML. XML, which defines document structures rather than how a browser should display a document, will give Web developers a lot more flexibility. It changes the way browsers display, organize, and search information. It could even make broken links a thing of the past. There are rumors that the next version of the Netscape browser (due this spring) will be XML-compliant. Netscape declined to comment. Microsoft has already built an XML-compliant application with the Channel Definition Format. Expect some major changes in the Web starting at the end of this year as sites start using XML.

It is important to note that HTML and XML are not competitors: They complement each other. Browsers will be able to process both, and future HTML standards will likely allow mixing HTML and XML in the same document.

For its part, DHTML aims to provide richer graphics and data with fewer, faster page downloads. In particular, it makes it easy to present information differently depending on user feedback. DHTML is currently undergoing some standards-body fighting as Microsoft and Netscape pitch their different flavors for ratification by the W3C.

Style sheets enable you to create pages that inherit properties from other pages. Currently, CSS goes hand-in-hand with HTML. It appears that XML, too, will have style sheets, specified using the Extensible Style Language (XSL).

W3C's Document Object Model (DOM), now a draft recommendation as part of the DHTML spec, will allow HTML and XML scripts, and other programs, to access structured data under program control. DOM also adds object orientation to page layout and design. For example, HTML elements appear as objects and collections that expose properties and methods. Developers can use DOM and a scripting language, such as JavaScript, JScript, or VBScript, to manipulate the DOM and achieve dynamic styles, content, and positioning. Scripts can manipulate positioning attributes to create animations on an HTML page.

DHTML, and to some extent DOM, have had a rougher birth than XML, with Microsoft and Netscape taking radically different tacks toward serving up dynamic content and defining Web elements as objects. Let's take a closer look at some of

New Tools for a New Web

XML-enabled tools will be the next big wave. More than 150 SGML software packages will be fitted with an XML output filter within months of the final adoption of XML 1.0. There will also be some XML support for non-SGML word processors—which makes sense as long as they are capable of producing some kind of structured text. On the receiving end, expect XML plug-ins for standard HTML-based Web browsers, XML support via Java apps, as well as full-fledged native XML browsers.

Adobe FrameMaker

Adobe is implementing support for XML in both FrameMaker and FrameMaker+SGML, expecting to ship the XML-enabled versions in the second quarter of this year.

In addition to creating structured XML documents, both FrameMaker and FrameMaker+SGML can convert unstructured documents to XML. In this case, they map paragraph and character tags to element names. Adobe's current implementation creates a cascading style sheet with each XML instance. XSL support, Adobe says, will be implemented "as the XSL specification becomes more stable."

ArborText Adept & Cedar

ArborText is a leading supplier of SGML software. The company's Adept Series lets users create and maintain textual and document information as reusable elements. It includes an interface for document management as well as Document Architect for handling DTDs and style sheets. It was recently upgraded with XML capability.

In December 1997 ArborText previewed its Cedar project at the SGML/XML conference in Washington, D.C. A downloadable beta version should be available by the time you read this. Cedar "is focused on the creation of style sheets based on XSL for XML documents." ArborText was (with Microsoft and Inso) one of the three companies that originally submitted the XSL proposal to the W3C in September 1997.

Grif doc+

Grif's Symposia started out as an HTML browser and editor, which Grif codeveloped with INRIA, France's national computer science research institute. At the time of this writing, Grif was beta-testing Symposia doc+, an intranet publishing solution that includes a WYSIWYG authoring tool, a database publishing mode, and a graphical site manager. A free evaluation version is available for downloading.

Microsoft Internet Explorer 4.0

Microsoft has been instrumental in the proliferation of XML so far, has codeveloped some of the related standards, and has developed the first public implementation of an XML engine, which is part of Internet Explorer 4. Currently Microsoft is giving away a number of tools, including MSXML, a validating XML parser written in Java. It checks for well-formed documents and optionally permits checking for validity. Once parsed, the document is exposed as a tree through a set of Java methods, which Microsoft is working with the World Wide Web Consortium to standardize. These methods support reading and writing XML structures, such as the Channel Definition Format (CDF), enabling developers to build XML-based applications.

these technologies that promise to revolutionize the Web.

XML: Bigger Than HTML, Smaller Than SGML

HTML is based on Standard Generalized Markup Language (SGML), a much larger metalanguage that predates the Web. SGML specifies grammars for document markup languages, and SGML documents bring their grammar definition with them in the form of the Document Type Definition (DTD). DTD specifies tags used in the document and the meaning of those tags.

HTML is a single SGML application—a hard-wired set of tags. HTML 3.2, for example, specifies about 70 tags and 50 attributes. Because HTML is a fixed, nonextensible grammar, HTML documents do not need to include the DTD. Its fixed nature makes HTML easy to learn and makes it easy to write HTML viewers. It also means that it can be very difficult to get HTML to do what you want.

The incredibly extensible SGML would fix that particular problem, but SGML is too cumbersome to learn and implement easily. Instead of bringing all of SGML to the Web, the World Wide Web Consortium has proposed a thinner version: XML. You can think of XML as a kind of SGML Lite, intended to bridge the gap between SGML's richness and HTML's ease of use in Web applications. XML is a metalanguage like SGML, but while changes to HTML require an update of the standard, XML is meant to be extended. As soon as an extension is specified within XML, it becomes universally available.

At the SGML/XML conference in Washington, D.C., last December, version 1.0 of the Extensible Markup Language specification was issued as a W3C Proposed Recommendation. Before that, W3C's XML Working Group, chaired by Jon Bosak of Sun Microsystems, had published several working drafts, edited by Tim Bray (Textuality/Netscape), Jean Paoli (Microsoft), and C. M. Sperberg-McQueen (University of Illinois at Chicago). Final ratification of XML 1.0 was due for late January.

XML was designed to be easier to use than SGML. As Richard Light writes in his book *Presenting XML*: XML offers "80% of the benefits of SGML for 20% of its complexity." The XML designers tried to leave out only those parts that are rarely used. That turns out to be quite a lot: The XML specification needs about 30 pages, compared to 500 for SGML. One objective of the XML Working Group is that experienced programmers should be able to develop an XML parser in a week. That said, XML is a verbose format compared to HTML, though compression features in newer versions of the Hypertext Transfer Protocol (HTTP) should ensure that XML documents download efficiently over networks.

What's the catch? XML is not compatible with today's HTML. For one thing, this means you'll need to upgrade your HTML browser to an XML browser. While SGML tools can handle XML (see "New Tools for a New Web," above), an XML tool will not be able to read all flavors of SGML—and one of those is HTML. That's because XML uses a slightly different syntax than HTML and enforces syntax rules more rigorously. (See "The Power of XML Syntax," page 63.) HTML documents will require changes, albeit minor ones, to become XML-compatible.

Why the changes? XML breaks the bounds of HTML's fixed set of tags, letting developers define an unlimited number of tags to describe any data element in a document. These data elements can be nested hierarchies of information, orga-

The Power of XML Syntax

If you're familiar with HTML, you know that it has a fixed set of tags that control the appearance of information (things like font names, styles, and sizes). In other words, HTML describes the presentation of information. XML, on the other hand, should describe the data, rather than the formatting; an external style sheet should control a document's appearance. Tags can be application-specific or they can be imported from a public Document Type Definition (DTD).

What all this means is that XML looks kind of like HTML, but its function is drastically different. The following example has tags for a book's title, price, author, and so on, much like fields in a database.

```
<ORDER>
 <SOLD-TO>
  <PERSON><LASTNAME>Layman</ LAST
   NAME>
   <FIRSTNAME>Andrew</FIRSTNAME>
  </PERSON>
 </SOLD-TO>
 <SOLD-ON>19970317</SOLD-ON>
 <ITEM>
  <PRICE>5.95</PRICE>
  <BOOK>
   <TITLE>Number, the Language of
    Science</TITLE>
   <AUTHOR>Dantzig, Tobias</AUTHOR>
  </BOOK>
 </ITEM>
 <ITEM>
  <PRICE>12.95</PRICE>
  <BOOK>
   <TITLE>Introduction to Objec-
    tivist Epistemology</TITLE>
   <AUTHOR>Rand, Ayn</AUTHOR>
   <ISBN>0-452-01030-6</ISBN>
  </BOOK>
 </ITEM>
 <ITEM>
  <PRICE>12.95</PRICE>
  <RECORD>
   <TITLE><COMPOSER>Tchaikovsky</COM
    POSER>'s First Piano Concerto</TITLE>
   <ARTIST>Janos</ARTIST>
  </RECORD>
 </ITEM>
 <ITEM>
  <PRICE>1.50</PRICE>
  <COFFEE >
   <SIZE>small</SIZE>
   <STYLE>cafe macchiato</STYLE>
  </COFFEE >
 </ITEM>
</ORDER>
```

In addition to the fact that none of these tags describes what the data will look like when you view it (that's up to the DTD), there are two other notable differences between HTML and XML:

First, note that each tag has a matching end tag (HTML is more lenient about this). Note also how elements are nested—an element may contain text and other elements, but elements may not overlap. XML calls anything that appears between an element's start and end tags the element's contents.

Second, XML documents should begin with a declaration of the XML version being used:

```
<?xml version="1.0"?>
```

This allows an XML "processor"—a kind of parser—to automatically recognize the version of a document it receives and reject versions it does not support. Unlike HTML browsers, which simply ignore syntax they don't understand, XML parsers can reject content.

nized just as naturally as papers within file cabinets. A valid XML document is one in which these hierarchies are properly defined and nested.

Declaring these tags and hierarchies at the outset greatly reduces the amount of procedural code a developer has to write to create a structured application. The downside: Developers can't embed any XML tag in any order in documents. Furthermore, for the XML document to be valid, each new tag must be included in a DTD, which can be stored in a separate file. (As a performance boost, a server can offer up an XML document without its DTD, in which case XML parsers can declare the document "well-formed" without having to refer to the DTD.) If the tags aren't embedded within each other properly, the parser declares the XML document invalid. All this validity checking is more work than HTML, but it yields greater rewards.

The benefits of reworking documents in XML are substantial. Because encoding Web content in XML makes the information's structure more accessible, it helps search engines return more meaningful results. (See "XML Namespaces," page 64.) XML also introduces concepts that will ease maintenance and make Web applications more stable, including bi-directional and externally stored links. Web clients can be more intelligent and take over tasks that are currently handled by the server.

XML's Structure and Language Elements

Although XML has many parts, you really need to know about three in order to understand how it works: the Document Type Definition (DTD), XML's layout language; the Extensible Style Language (XSL), XML's version of style sheets; and the Extensible Link Language (XLL), a system for handling links beyond HTML's hard-coded, in-line hrefs.

DTD The Document Type Definition specifies the logical structure of a document. It enables you to define the grammar of a document, which, in turn, enables an XML parser to validate a page's use of its tags (see "The Power of XML Syntax," at left). The DTD defines a page's elements and its attributes as well as the relationships among those elements and attributes. For example, the DTD can specify that a list item can occur only within a list.

Ideally, the definitions should be oriented toward describing the data structure associated with the application, rather than how the data should be displayed. In other words, define an element as a headline, and let the style sheets and scripts define how a headline should look. XML DTDs are getting a running start by leveraging the work done on DTDs for a range of applications for SGML. (See "Applications Will Drive XML Acceptance," page 61).

DTDs aren't mandatory. For simple applications, developers need not build their own DTDs (which is no mean task); they can use predefined, public DTDs, or none at all. Even if a DTD exists for a document, the parser may choose not to check the document's validity against the DTD (as long as the document is well-formed). The server may have already done the check—time and bandwidth will be saved.

XSL Extensible Style Language is the language used to specify style sheets for XML documents. XSL enables Web browsers to change the presentation of a document—for example, the order in which data is displayed—without further

XML Namespaces

We make a big deal out of the fact that XML describes data, not presentation information. But what good are data descriptions if you are the only one who describes a particular kind of data that way? XML allows authors to invent new element names and publish them for others to use and thus agree upon standard terms for common data elements. These published namespaces prevent name conflicts and indicate who defined a term. They also will make the work of search engines easier, as tags become more meaningful.

A name begins with a letter or one of a few punctuation characters, and continues with name characters, which include letters, digits, underscores, hyphens, colons, and periods. Names beginning with the string `xml` are reserved. Here's an example of some XML that calls two defined data description namespaces—one for an order, one for a digital signature (such as a VeriSign signature):

```
<xml>
 <xml:schema>
  <namespaceDcl href="http://www.company.com" name="co"/>
  <namespaceDcl href="http://www.dsig.org" name="dsig"/>
 </xml:schema>
 <xml:data>
  <ORDER>
   <SOLD-TO>
    <PERSON><LASTNAME>Layman</LASTNAME>
     <FIRSTNAME>Andrew</FIRSTNAME>
    </PERSON>
   </SOLD-TO>
   <SOLD-ON>19970317</SOLD-ON>
   <dsig:DIGITAL-SIGNATURE>1234567890</dsig:
    DIGITAL-SIGNATURE>
  <ORDER>
 </xml:data>
</xml>
```

An author can also specify an element's data type and format. A `lextype` attribute can be used for this purpose:

```
<SOLD-ON lextype="DATE-ISO8061">19970317</SOLD-ON>
```

"`DATE-ISO8061`" specifies that `SOLD-ON` contains a date in the format specified by ISO 8061. Authors can design their own data types and use public types. Microsoft is working with the World Wide Web Consortium to define a set of standard types and will publish a list that anyone can freely use.

interaction with the server. By switching style sheets, the same document can be displayed in large print or Braille, collapsed to show just the outer hierarchical layers, or formatted for print. Imagine a technical manual that adapts to the learning curve of the user: It has styles for beginners and for the more advanced, all generated from the same text base. (Now you see why the DTD shouldn't control how the information is displayed.)

XSL can handle an unlimited number of tags, each in an unlimited number of ways, by virtue of its extensibility. It brings advanced layout features to the Web, such as rotated text, multiple columns, and independent regions. It supports international scripts, all the way to mixing left-to-right, right-to-left, and top-to-bottom scripts on a single page.

Much as XML takes the middle ground between HTML and SGML, the proposed XSL standard takes the middle ground between CSS and SGML's Document Style Semantics and Specification Language (DSSSL). DSSSL defines a full-featured model for formatting objects. Widespread implementation of DSSSL may have been impeded because it uses Scheme syntax, and because it is very complex. In comparison, CSS uses a simpler model (for example, it cannot reorder elements). The XSL proposal supports DSSSL flow objects and CSS objects, uses XML syntax and a declarative language, and provides an escape into ECMAScript for complicated tasks and to allow extensions. Mechanical mapping from CSS to XSL will be possible—content developers need not learn the full language.

As a technology preview, Microsoft recently released two XSL processors: a command-line utility that produces HTML output from an XML document and an XSL style sheet, and an ActiveX control for displaying XML in a browser. The Microsoft XSL Processor runs on Windows 95 and Windows NT (x86 only) with Internet Explorer 4.0.

XSL is a bit behind the timetable for XML. ArborText, Inso, and Microsoft submitted a proposal for XML to the W3C in August 1997 as a note for discussion. The W3C is creating a separate XSL working group because completing XSL requires a different range of expertise than previous components of XML.

XLL XML's Extensible Link Language will support simple links as they exist on the Web today, but it will go on to implement extended links, including indirect links that can put an end to the dead links and the connector "|" that causes only the relevant part of an element to be retrieved from the server.

In the words of Jon Bosak, who chairs the XML Working Group, "HTML, this so-called 'hypertext markup language,' implements just a tiny amount of the functionality that has historically been associated with the concept of hypertext systems. Only the simplest form of linking is supported—unidirectional links to hard-coded locations. This is a far cry from the systems that were built and proven during the 1970s and 1980s."

In a true hypertext system of the kind envisioned for the XML effort, Bosak explains, all the classic hypertext linking mechanisms will be supported:

- location-independent naming
- bidirectional links
- links that can be specified and managed outside of documents to which they apply
- n-ary hyperlinks (e.g., rings, multiple windows)
- aggregate links (multiple sources)
- transclusion (the link target document appears to be part of the link source document)
- attributes on links (link types)

These will be achieved through XLL, which is currently under development. As XML is based on SGML and XSL on DSSSL, XLL is basically a subset of HyTime

Summary of DHTML Benefits

Benefit	Microsoft DHTML	Netscape DHTML	Description
Dynamic styles	✔	✔	Change the appearance of styles on a Web page.
Dynamic content	✔	✔	Change the content on a Web page.
Dynamic positioning	✔	✔	Move the position of content on a Web page.
Font embedding	✔	✔	Download fonts with a Web page so content always displays in a specified font.
Data binding	✔		HTML extensions that facilitate tight client-side integration with data sources. Current Microsoft approach relies heavily on ActiveX controls.
Filters and transitions	✔		Filters and transitions to achieve low-level multimedia effects, such as fades, glows, drop shadows, and checkerboard transitions.

✔=yes

Other XML Tools and Applications

Copernican Solutions XML Developer's Toolkit
http://www.copsol.com/products/xdk/XDK
Checks, validates, loads, and accesses XML documents.

Norbert's XML Parser
http://www.edu.uniklu.ac.at/~nmikula/NXP/
Used during development of XML; downloadable from NXP Web site.

Jade
http://www.jclark.com
Will be one of the first packages to support XSL; downloadable from Jade Web site.

Silknet eService 98
http://www.silknet.com/
Enterprise customer-service application will support XML during 1998 to integrate data from Vantive, Scopus, and Remedy customer-service applications.

(Hypermedia/Time-based Structuring Language, ISO 10744). It also follows linking concepts specified by the Text Encoding Initiative.

Where Is XML Going?

Since development began in September 1996, XML has acquired an avalanche's momentum. Version 4 of Microsoft's Internet Explorer supports XML, and Netscape may have followed suit by the time you read this. Many other companies, including Adobe, ArborText, Sun, and Xerox, have announced their support. XML will no doubt become the vehicle for publishing SGML-based information on the Web.

Netscape has proposed combining the Meta Content Framework (MCF) with XML. Microsoft based its Channel Definition Format (CDF) on XML.

According to Bosak of the XML Working Group, the applications that will drive the acceptance of XML can be divided into four broad categories:

1 Applications that require the Web client to mediate between two or more heterogeneous databases.

2 Applications that attempt to distribute a significant proportion of the processing load from the Web server to the Web client.

3 Applications that require the Web client to present different views of the same data to different users.

4 Applications in which intelligent Web agents attempt to tailor information discovery to the needs of individual users.

One of the applications that falls into the first category is electronic commerce, particularly if based on Electronic Data Interchange (EDI). In this context, it comes in handy that the structure XML brings to Web data makes it easier to attach digital signatures, as well as to encrypt a document or parts of it. The W3C Digital Signature Initiative is working on XML-based security and authentication. In other applications, where automation and information reuse are required, XML will complement HTML. Whatever the future, the transition will be smooth and users will not have to suffer.

DHTML: HTML Gets Richer

XML, despite any technical advantages, is still new and different from HTML. Many Web developers are going to have problems migrating large sites to XML or training their staffers to work with this more sophisticated language. Wouldn't it be better to just extend HTML's capabilities while maintaining at least some of the familiar syntax? Netscape and Microsoft, with the 4.x releases of their respective browsers, introduced something that each called Dynamic HTML (DHTML). The concept: provide richer graphics and data with fewer, faster page downloads.

Three core benefits of DHTML include dynamic styles, content, and positioning. Dynamic styles enable developers to change the appearance of content without forcing users to download all the content again. Dynamic content lets developers change the text or images that appear on a page so that content can respond interactively to user mouse and keyboard behavior. Dynamic positioning lets page authors move text and images around a page either automatically or in response to user behavior.

Unfortunately for developers, Netscape and Microsoft implemented DHTML differently. The two different DHTML flavors deliver a mixed bag of benefits (see the table above). Until the W3C releases a DHTML standard, we will likely continue to see few pages that take advantage of this capability.

DHTML's Four Parts

Web developers can combine four things to create dynamic Web pages: cascading style sheets (CSS), HTML 4.0, Document Object Model (DOM), and scripts.

HTML 4.0 In December 1997, the W3C issued a final specification for HTML 4.0. Its many enhancements include incremental display of large tables, scrollable tables with fixed headers, and better support for printing long tables. Enhance-

ments to HTML forms focus on making them more flexible. A new Button tag enables forms to have more than just Submit and Reset buttons. An `accesskey` attribute provides keyboard shortcuts to form fields. An `accept` attribute for the Input tag permits authors to designate valid content. Character sets get a boost: The legitimate HTML 4.0 character set extends beyond the one for Western European languages while still maintaining HTML documents in conformance with SGML.

CSS Controlling the presentation of a document written in a language like XML or HTML, cascading style sheets allow more precise layout and formatting than HTML alone. A new version of CSS is on the horizon: W3C's draft statement for CSS2 at the time of this writing includes a chapter devoted to aural style sheets. Aural rendering of HTML documents will help sight-impaired users gain convenient access to Web content. It can also serve other contexts, such as in-car use, presentation over a home entertainment system, and teaching pronunciation of words.

CSS2's specification chapter on the visual rendering model describes relative and absolute positioning issues. These designate rules for the two-dimensional layout of content in an HTML document. A section within the chapter addresses stacking issues that define how to arrange content in a third dimension.

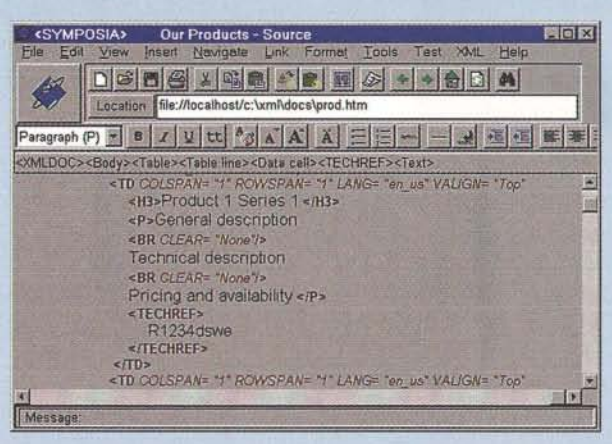
DOM The third major DHTML component that the W3C is creating specifications for is the Document Object Model, which will define a platform-independent programmatic interface to HTML documents. This interface will be able to manipulate the content, structure, and style of the document. With DOM, Web developers can introduce dynamic and interactive content into their Web pages without having to rely on a Web server to provide new content or to change how existing content displays. The W3C will provide DOM bindings for Java and ECMAScript. The DOM FAQ indicates an independent group will submit a COM interface to the DOM that will appear as a W3C Note. There are expectations that various firms will provide bindings for other languages, such as Perl, C++, and VBScript.

Scripts The fourth DHTML component is scripting, and W3C proposes to issue an initial binding of its DOM to

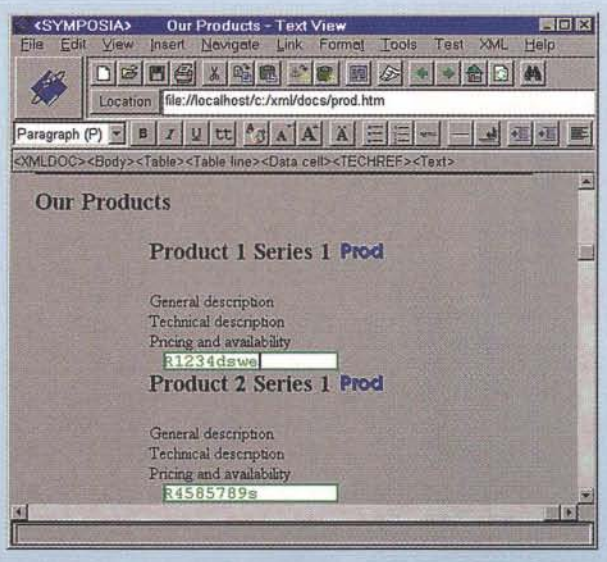
Creating XML Objects

The following three screenshots show an XML document being imported into an XML-enabled HTML editor (Grif's Symposia Pro). During import, the tool verifies that the document is "well-formed." If it encounters tags that are not recognized (i.e, they do not belong to the HTML 3.2 Document Type Definition, or DTD), it automatically builds new tag definitions. The document is displayed using HTML 3.2 tag formatting rules, with default rules for new tags. The user can then interactively add cascading style sheets (CSS) style rules to improve the display of these new document elements.

The user can define and insert new tag definitions at any time, using the Add New Tag command. SGML editors, as well as other document authoring tools, are also adding the capability to create XML tags like these.

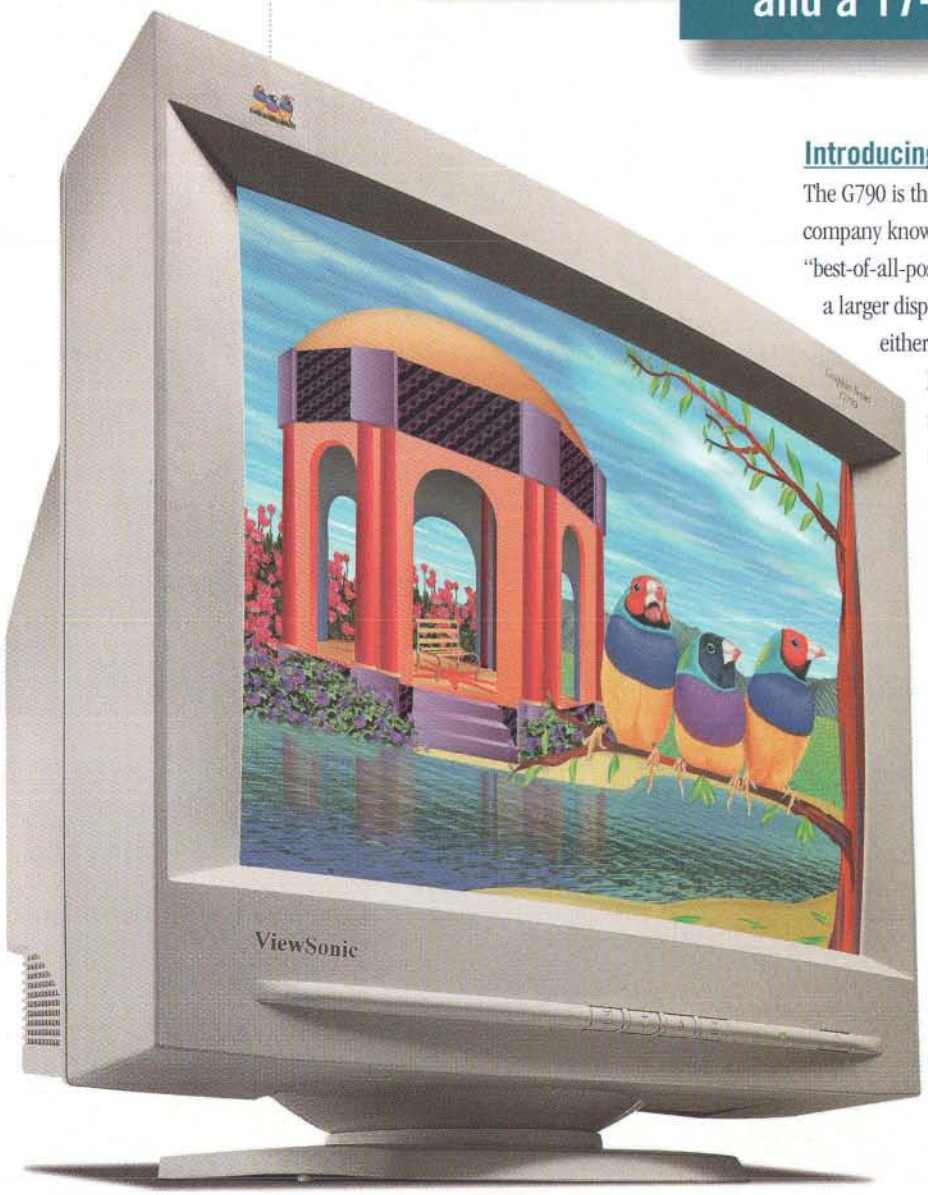


New tags are inserted in the structure. The user can interactively specify the way they should be formatted by associating a set of CSS style rules. Content of new tags can then be entered interactively in WYSIWYG mode.



User-defined tags are saved in the XML structure, and the CSS style sheet definition remains associated with them. The document can be read by any other tool that supports XML and CSS specifications.

For people with 19-inch eyeballs and a 17-inch work space.



Introducing our latest big idea.

The G790 is the latest innovation from ViewSonic,® a company known for taking the lead. It's one of those rare "best-of-all-possible-worlds" solutions for those who need a larger display area but don't want to compromise either screen performance or desktop space. It's the first 19" display (18.0" viewable) made by ViewSonic, and while its screen size is big, its footprint is small, taking up about the same space as a typical 17" (various viewables) monitor.

No small-fry when it comes to performance.

For graphics users, web pros, business types and home surfers alike, the G790 is a big performer. It has a super fine 0.26mm true dot pitch and flicker-free optimal resolution of 1,280 x 1,024 at an 88Hz refresh. In other words, it's razor sharp. And with a vertical scan rate of 180Hz, it even displays flawless 3D applications. Check out the G790 for yourself. It's a real eye-opener.

ViewSonic G790

- 19" Display (18.0" Viewable)
- .26mm true dot pitch
- 1,280 x 1,024 optimal resolution at 88Hz
- TCO Compliance
- SuperContrast™ screen

For the dealer nearest you, call ViewSonic at (800) 888-8583 and ask for agent 81150, or visit our website at: www.viewsonic.com.

ViewSonic®
See The Difference!™

(909) 869-7976 Fax: (909) 869-7958 • Internet: //www.viewsonic.com • Specifications subject to change without notice.
Copyright © 1997 ViewSonic Corporation, all rights reserved. • Corporate names and trademarks are the property of their respective companies.

ECMAScript. The European Computer Manufacturers Association (ECMA; http://www.ecma.ch/) issued an initial version of ECMAScript-262 in June 1997. Another version is due in 1998. Microsoft reports that its version of JScript in Internet Explorer 4.0 is compliant with ECMAScript. Extra features in Microsoft's JScript, including COM support, do not violate its conformance with ECMAScript. Netscape's JavaScript 1.2 is not compliant with the current ECMAScript version. The next releases of the Netscape browser and ECMAScript will bring the two into conformance.

Browser Wars

So, those are the parts of DHTML. They seem simple enough, yet DHTML probably won't be standardized until well after you see XML as a standard part of your browser. Why? The browser wars: Netscape wants to do things its way, and Microsoft wants to do things its way.

In order for DHTML's components to interact successfully with one another, they must be compatible with one another. The browser must recognize both the HTML and the CSS syntax. DOM must expose HTML and cascading style sheet elements. The scripting language must recognize the browser as a host, and it must be able to respond to object events while it manipulates object and collection properties and invokes their methods.

Unfortunately, each company has its proprietary extensions to selected components. In general, Microsoft's implementation is more faithful to the current W3C recommendations, possibly because it released its 4.0 browser later than Netscape. Here are some examples.

Microsoft's approach to dynamic styles, positioning, and content exposes all HTML tags as elements and lets page authors directly manipulate their properties as well as allowing dynamic reflowing of the text and images on a page. Netscape's approach exposes fewer elements and relies heavily on layers of HTML content. Authors establish these content layers with layer tags or CSS positioning coordinates. By changing the properties of the layers with JavaScript, page authors can achieve dynamic effects after a page loads. Developers using Netscape's Visual JavaScript Pro can drag and drop HTML, Java, and JavaScript components from a component palette to a Web page. They can also drag third-party JavaBeans and CORBA services from the component palette. Developers can visually build event-based connections or bound property values for two components so they remain synchronized. The package supports Oracle, Informix, Sybase, or ODBC data sources using the included JavaScript components that leverage database connectivity in Netscape Enterprise Server 3.0. A custom property editor enables developers to build interactively a SQL statement for specifying a data extract.

Fonts are another area of contention. Downloadable fonts allow an author to determine the precise font family for text whether or not that font already resides on the browser's workstation. Netscape relies on a font definition file that links to a Web page of installed fonts from any source. Microsoft's approach extends CSS notation to reference font styles. It also incorporates support for Microsoft True Type fonts.

Data binding and multimedia effects are another problem. Only Microsoft's DHTML implementation supports these. Data binding makes it easy and fast for surfers to interact with a data cache in a page because filtering and sorting operations on a local cache do not require a round trip to the server. Also, page authors can apply filters and transitions through style sheets, in-line style attribute settings, and scripts. A set of 14 filters, such as Blur and FlipH, can add multimedia effects to HTML content. Web developers can also invoke transitions for entering or leaving a URL.

The purpose of standards is to create a reference for the components so browser manufacturers can have a minimum set of requirements to meet. Then, at least for some core set of functions, DHTML code will behave consistently across browsers that are in conformance with the standards. As browser manufacturers strive to deliver the best value to their clients, we can expect a continuing stream of extensions to the standards that result in differences outside the core functions.

The two standards organizations, W3C and ECMA, are busy issuing DHTML component specifications. When these organizations finish their work, browser manufacturers will have an open set of specifications to which they can conform for cross-browser compatibility.

Call to Arms

HTML isn't dead, but it is suffering from its own success—and every time you get a "404 URL not found" error message, you're suffering, too. In order to keep the Web growing and push its power into more applications, we need to start replacing simple HTML with more powerful alternatives. Perhaps the most powerful alternative within reach is XML 1.0, the recently ratified standard. Its power is that it forces developers to describe content rather than presentation.

Couple XML with style sheets (which *do* control presentation), scripting, and a document object model (which enables developers to change content without revisiting a server) and you have a solution to problems as diverse as too many AltaVista hits and poor performance. Although it will require developers and users to retool, the migration to XML must begin. The future of the Web depends on it. B

WHERE TO FIND

Adobe
San Jose, CA
408-536-6000
http://www.adobe.com

ArborText
Ann Arbor, MI
313-997-0200
http://www.arbortext.com

Grif
St. Quentin en Yvelines Cedex, France
+33 (0)1 30 12 14 30
http://www.grif.fr

Macromedia
San Francisco, CA
415-252-2000
http://www.macromedia.com

Microsoft
Redmond, WA
425-882-8080
http://www.microsoft.com/standards/xml

Netscape
Mountain View, CA
650-937-2555
http://www.netscape.com

Scott Mace is a senior editor at BYTE. He can be reached at **scott.mace@byte.com**. *Udo Flohr is a BYTE contributing editor based in Hannover, Germany. You can reach him by sending e-mail to* **flohr@dfn.de**. *Rick Dobson, Ph.D., is president of CAB, Inc., a database and Internet development consultancy. You can reach him at his firm's Web site,* **http://www.cabinc.win.net**. *Tony Graham is an SGML consultant with Mulberry Technologies, Inc. (Rockville, MD) and the maintainer of the DSSSL users' mailing list. You can reach him at* **tgraham@mulberrytech.com**.

You'll either get it.

Or you won't.

BYTE Best of Show/CeBIT '98
Call for Entries

Does your company "get it"? Is your new product truly innovative? Does it have the potential to change business computing worldwide? If so, the editors of BYTE want to know about it. They'll be on hand at CeBIT in Hannover, Germany (March 19-25) to preview* new products for our annual Best of Show/CeBIT '98. Winners will be honored at a formal ceremony at 3:00 pm at the TCM Conference Center on Monday, March 23. (Finalists will be notified in advance.)

There is no entry fee, but to qualify products must have been announced within 90 days of CeBIT and be on display at the show**. To enter, simply send us a press release, product data sheets, your booth number and exhibit hall by March 9, 1998. And maybe, just maybe, you'll get it.

Rainer Mauth, BYTE European Editor
The McGraw-Hill Companies/BYTE magazine
Emil-von-Behring-Strasse2 D-60439 Frankfurt, Germany
Tel: +49 69 5801-123 Fax: +49 69 5801-145

Or download a nomination form at: www.byte.com
and submit your entry via e-mail at Cebit98@byte.com

*BYTE editors make the decision to review products on the show floor based on the press release and other product information. Not all products nominated by companies will be personally reviewed by a BYTE Editor.
**BYTE editors reserve the right to determine the eligibility of any company entering this competition.

BEST OF SHOW:
Portable
Communication
Software
Communication
Hardware
Peripheral
Multimedia Software
Multimedia Hardware
Internet Product
System
Application
Development Software
Technology

BYTE

The Future of Information Technology Today

Technologies that make the application programmability vision a reality.

By Bill Gates

Ten years ago in BYTE, I proposed a software architecture vision that would greatly extend the power and scope of application macro languages. In "Beyond Macro Programming," I outlined the problems with numerous proprietary macro languages, each tied to a particular application. I expressed the need for Interapplication Communication (IAC) and control using a common development language and environment. This would free developers from learning the idiosyncrasies of each language and focus instead on the core functionality of applications. I also called for the creation of object models that would enable developers to control all the elements of an application, providing full application programmability. It took more than two years to see this vision realized, but 10 years later, application programmability achieved higher levels than anyone would have imagined a decade ago.

Future developments will be driven by the same three factors that have propelled us to this point. First, broad adoption of standards and technologies such as COM and Visual Basic for Applications will provide the foundation for application customization and automation. Second, every end-user feature we add to applications to make people more productive should be accessible by a solution developer. Third, the reach of both application automation and the information derived from its use must be extended as far as possible, using existing technologies such as the Internet as delivery mechanisms.

How far have we come in 10 years? Perhaps the most important development in terms of application automation (and distributed computing in general) was the maturation of a common application protocol. The Component Object Model (COM), and our most recent initiative, COM+, is the foundation for IAC and control. By defining a standard way for software components to share information, we have constructed the foundation on which integrated applications can run.

The second most important achievement has been the development of a common, component-driven language engine, Microsoft Visual Basic for Applications (VBA). VBA meets the requirements for a program-creation tool and program engine that I outlined 10 years ago.

The most powerful and compelling aspect of VBA is that it is truly shared among many applications. The programming experience is the same regardless of whether a developer is working with Excel, Word, AutoCAD, Visio, or Great Plains Dynamics (starting in June 1996, Microsoft began licensing VBA to third-party software developers). The only difference to the developer is the object model and functionality that are provided by the host application components.

VBA derives its components using software designed around COM. It is not enough for component developers to expose functionality via COM interfaces. Solution developers must have powerful and productive programming tools with which to control these interfaces. VBA fulfills this need.

ILLUSTRATIONS: JANE STERRETT © 1998

VBA and COM

In a certain sense, VBA is moving beyond being a single technology and is fast becoming a standardized *platform* for development, just like Windows and the Internet.

Moving Forward: The Next 10 Years

The next decade will see many things change. But one thing will stay the same: Companies will have to do more with less. To a large degree, this means moving away from custom applications toward the integration of existing components, solutions, and business processes. More and more companies and industries are standardizing on the same platform and architecture. In this environment, the competitive advantage comes from customizing off-the-shelf applications to map to creative and efficient business practices.

This "buy and customize" approach offers the best of both worlds: rapid development with the ability to integrate business processes while taking advantage of an application's core functionality. You will evaluate software applications on how extensively and easily you can customize them. COM and VBA are the pivot points for automating and enhancing this integration. By adding COM interfaces to existing applications, developers can open their capabilities to other applications. They can then access these capabilities from other applications through VBA. Furthermore, having VBA broadly available in applications throughout the enterprise enables developers to extend their expertise to more applications.

The Component Object Model (COM), and our most recent initiative, COM+, is the foundation for Inter-application Communication and control.

But these seeds are already planted and growing. Looking forward, what goals should we set in order to meet the requirements of customization and integration while maintaining existing investments? I've identified five aspects of application programmability that must be enhanced in the next decade:

- object-model convergence
- Internet integration
- data representation
- componentization
- enhanced user involvement

Object-Model Convergence

With VBA becoming the predominant application programmability language, the greatest cost associated with working with a particular component or application is no longer adapting to a different language and tool set, but rather the need to learn that component's object model.

In the next decade, developers seeking to create integrated solutions will demand as much convergence of object models as possible across all applications. Components will be judged on how much their object models resemble those with which developers are already familiar. Eventually, object models, like programming environments, will become similar enough so developers can focus on the core functionality of a component. Likewise, component vendors can spend more effort refining the true added value of their software.

Internet Integration

The Web is about much more than browsers. It's about connectivity that has radically increased the amount of data available to any individual. Technologies such as Web Queries have already enabled Web-based data to be integrated directly into desktop solutions such as Microsoft Office.

In the future, a component's location on the network must become as irrelevant to the developer as its source language is today. Developers will expect to be able to compose, distribute, and troubleshoot solutions wherever, whenever. Distributed COM (DCOM) is just the beginning. Directory services must merge with COM to provide a catalog of components from which a developer can shop. Debugging tools must be enhanced to account for issues that arise in a distributed environment, such as network load, communications protocols, and security. The work necessary to create such a seamless distributed development environment is under way as part of Windows DNA.

Data Representation

One of the most perplexing issues revolves around how components represent data. Many of the applications that expose data are COM-enabled, but the way that they expose data differs—the concept of data in a database is different from data in a spreadsheet or slide presentation. As components continue to evolve, they must be able to represent data in a way that is, while not identical, at least transferable. Components must be able to describe the data they contain when interrogated, and this data must be easily manipulated, regardless of its source. We must develop a set of rules that enables us to describe data both

precisely enough to implement using existing language technology and generally enough to capture the richness of data.

Microsoft is solving this problem in phases. Initially, we will use the Extensible Markup Language (XML). Like HTML, XML is a system that encodes data using named tags. Unlike HTML, however, XML is designed to describe the content, rather than the presentation of data (for more information on XML, see "Weaving a Better Web" on page 58).

Developing rules for representing data as a series of linked concepts rather than a precise structure tied to a specific application will extend this approach. By creating a way for the semantics of data to be expressed as a set of predefined concepts, software developers could construct query and analysis tools applicable to all forms of information.

Componentization

Solutions based on Microsoft Excel assume that most of the application functionality is necessary for the solution to run. At the same time, traditional software development has moved to a component-based approach that emphasizes smaller, single-purpose building blocks such as ActiveX controls and DLLs.

In the next 10 years, these two models must be reconciled and merged. When an application responds to an automation request from another program, it should be smart about loading into memory only the code absolutely necessary to satisfy the request. If these applications aren't made more intelligent, they risk being undermined by stand-alone components that offer less functionality but use fewer resources.

As VBA becomes the language of choice for application programmability, vendors should pair it with sophisticated macro-recording technology.

Applications such as Microsoft Office represent years of development effort and provide incredible functionality to developers and end users. The easier it is to create robust, high-performance solutions using Office, the more solutions will be created. Part of our effort has been to ensure that all the functionality that an end user can tap into is made available to developers. We've accomplished this by constructing comprehensive object models comprising discrete functional components and exposing them via COM. When an application is called on to provide one of these discrete components, it should do it in a way that has the least impact on system resources.

This doesn't mean that all current applications will become just a box of parts that developers scrounge through. Developers will lean toward several key applications as their core components, because of feature sets, robustness, and the like, just as they rely today on other familiar tools. How well an application exposes its components, though, will be one consideration.

Another important aspect of componentization is the ability to combine components into new components. For example, using Visual Basic, a developer can assemble both built-in controls and existing ActiveX controls into an entirely new ActiveX control with a customized set of interfaces. VBA offers this ability now through a feature called *class modules*.

On a larger scale, as more applications integrate, VBA developers will be able to create solutions that span the entire line of business by using customized components created using different applications. Accounting programs can be linked to the manufacturing and sales process, and post and retrieve information via the Internet—all possible by using the already-existing functionality of VBA-enabled applications.

Enhanced User Involvement

One advantage that application customization has over traditional software development is that end users are intimately involved in the development process, so solutions closely meet their needs. Application vendors must find ways to further engage end users.

One of the best ways to do this is to capture user interaction through some type of macro recording. This lets end users participate in the development process not only by creating content but by prototyping automation functionality. Developers can then examine and/or use the recorded macros to construct a more robust solution by adding error handling, parameterization, and common code routines from other projects.

Microsoft has worked to enhance the macro-recording capability of its products. As VBA becomes the language of choice for application programmability, vendors should pair it with sophisticated macro-recording technology.

The more sophisticated and intelligent the technology, the more useful the resulting code. For example, macro recorders should take advantage of language features such as For Each loops and With statements. Doing so will produce source code that is streamlined, efficient, and suitable for reuse by a professional developer. Not only will this make end users more productive and self-sufficient, it will aid developers by providing a learning tool for understanding an application's capabilities.

Conclusion

I recently outlined the concept of a company's "digital nervous system," the way in which a company uses technology to gain important insights to respond to planned and unplanned events.

One of the key requirements of that nervous system is a software-creation process that uses existing components and infrastructure to produce useful solutions in a short amount of time. Application programmability will continue to play a key role in the construction of digital nervous systems in companies of every size, structure, and industry.

This fact speaks to one of the three goals of application programmability—to fully expose application functionality to developers so that they can create solutions more quickly. Accomplishing this depends on the second goal, which is adherence to standards and adoption of enabling technologies such as COM and VBA. As these and other technologies become more pervasive, application developers will be able to reach more users and interact with more data. Finally, making the product of the digital nervous system instantly available throughout the organization, using the Internet and Windows DNA technologies, ensures maximum impact and flexibility with minimal friction and inefficiency. B

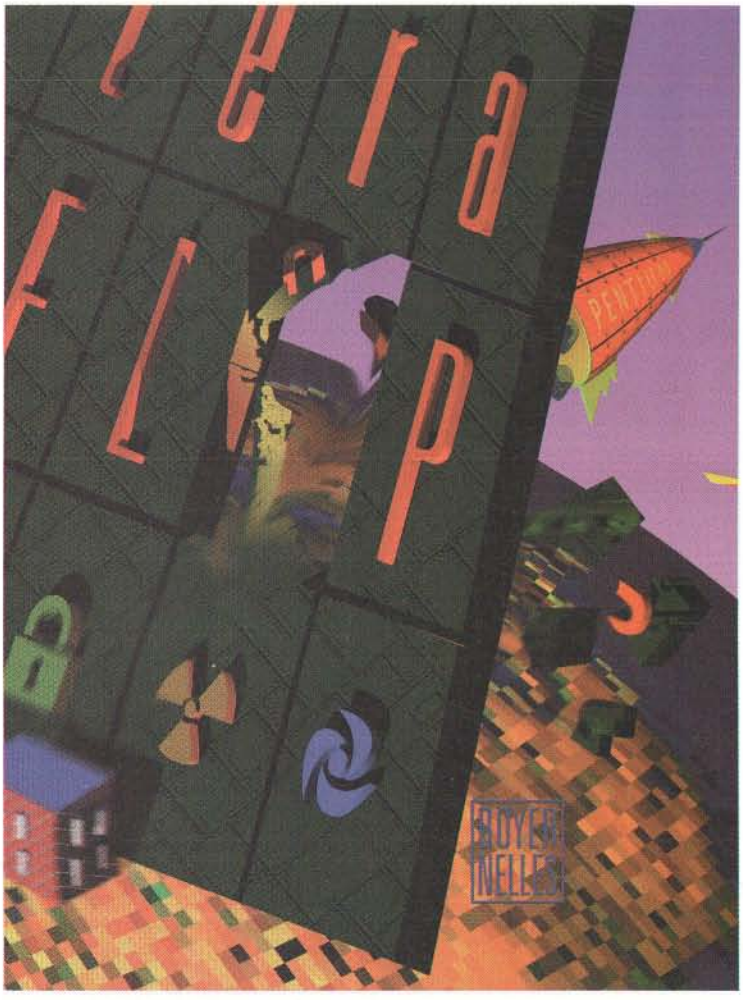
Bill Gates is the chairman and CEO of Microsoft.

www.byte.com

TeraFLOPS POWer

Sandia Labs puts the Pentium to work on the largest problems.

By Dick Pountain



On December 17, 1996, at the Sandia National Laboratory in Albuquerque, New Mexico, another milestone in computing history was passed: An Intel supercomputer performed one trillion floating-point operations per second, or 1 teraFLOPS. Said Intel's chief operating officer Dr. Craig R. Barrett: "Today's accomplishment is computing's equivalent to breaking the sound barrier."

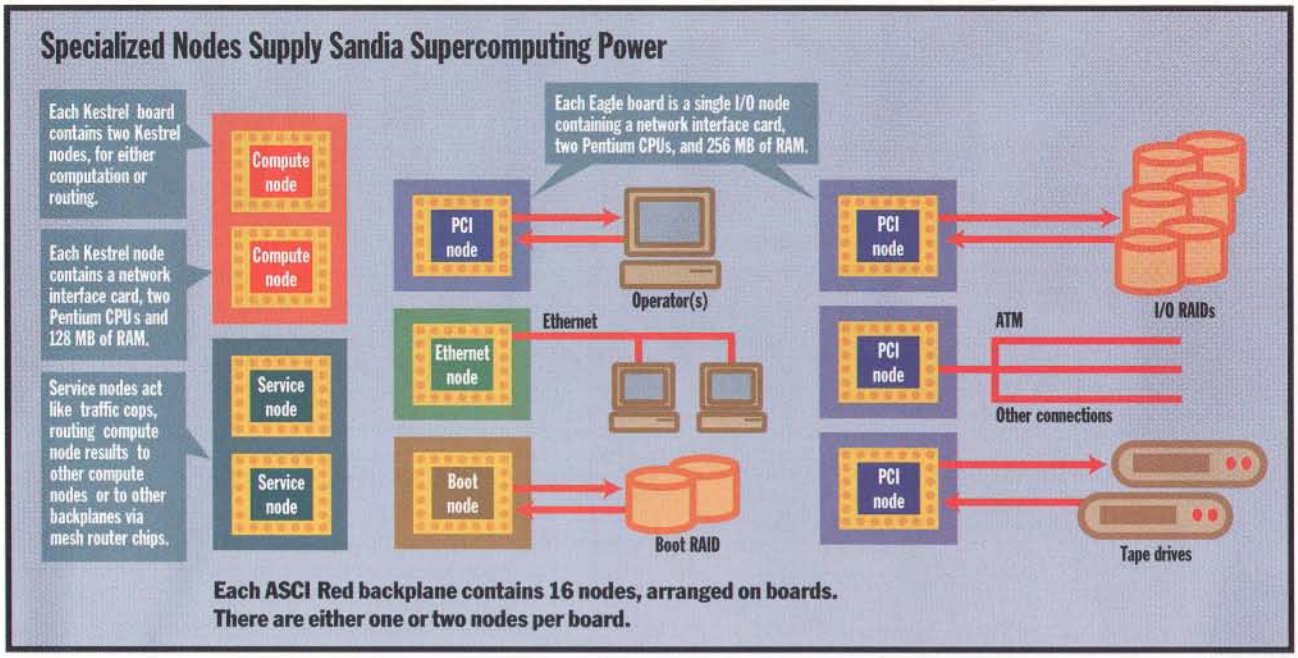
Breaching the teraFLOPS barrier had been the goal of supercomputer designers for many years. But who needs that amount of computing power? The answer, at the moment, is the U.S. government. The Intel supercomputer, called ASCI Option Red, is owned by the U.S. Department of Energy, and its rationale can be summed up in a single word: simulation. The U.S.A. has committed itself to ending the underground testing of nuclear weapons, but the need remains to test whether weapons in the existing stockpile are still effective. Computer-based modeling, simulation, and virtual prototyping form the backbone of the effort to verify the safety, reliability, and performance of the U.S. nuclear stockpile, and the Accelerated Strategic Computing Initiative (ASCI) is one element of the DOE's Stockpile Stewardship and Management Program. ASCI's planners have determined that simulating nuclear weapons to the required level of detail will create a demand by 1999 for machines that can perform 10 to 30 teraFLOPS and by 2004 a need for 100-teraFLOPS systems.

There's no mystery about how all this computing power gets used. Simulating a nuclear warhead impact—or for that matter crash-testing a new car or predicting the weather over the Atlantic—involves dissecting everything that happens within a region of space into a 3-D grid of cells and then applying equations of motion, elasticity, or gas diffusion to the contents of each cell at successive time intervals. Since there would be millions of these cells, they must be calculated on a parallel supercomputer that assigns the cells to different processors and computes them concurrently. ASCI Red is massively parallel, containing over 9000 Pentium Pro CPUs (though only 80 percent of the system had been installed when it reached the teraFLOPS level).

The resolution of a simulation, exemplified by how small its cells are, has enormous bearing on its realism. But in practice, resolution is limited both by how much memory the supercomputer can address (for cell storage) and by how long you can wait for it to compute each time step. Hence the demand for memory and computing power in simulation is almost limitless; you would eventually want one cell per molecule and computation in real time (or maybe better).

Weather forecasting is another field where there's no end in sight to the demand for computing power. Modeling the atmosphere involves a 3-D grid of cells, too, but the resolution is limited by absolute time constraints. The U.K. Meteorological Office currently uses the world's third-fastest supercomputer, a Cray/SGI T3 with 700 processing nodes, running a model of the world atmosphere at 60-km resolution, which increases to 17-km resolution over the U.K. to capture extra detail. According to the Meteorological Office's Alan Dickinson, "If we were to run with the U.K. resolution over the whole globe, the computational cost would be 125 times greater, and a 24-hour forecast would take 24 hours to complete!" In climate modeling, increasing the resolution can make whole new classes of structure visible, like ocean eddies or individual clouds, which can dramatically affect the

ILLUSTRATION: LYN BOYER-NELLES © 1998



accuracy of the modeling. For example, increased computing power will play a crucial role in resolving the arguments over global warming, one way or the other.

The greatest consumer of FLOPS is classified, namely cryptography. Breaking the largest public-key codes remains a priority for government intelligence agencies.

Then there are real applications that even a teraFLOPS machine can't touch. The revolution in molecular genetics is shifting the pharmaceutical industry's interest toward proteins and peptides rather than simple synthetic chemicals. Automated equipment now makes it relatively easy to establish the amino acid sequence of a protein, but what determines its biological activity is the way the protein coils and folds on itself to create the active site (a hole shaped like the target molecule). A computer that could predict the folded conformation of a protein from its sequence would have enormous commercial value for drug designers, but this process would involve trying out every possible folding of a long bead-like chain while calculating the forces of interaction between hundreds of atoms at each step. If possible at all, it would require computing power on the order of petaFLOPS (10^{15} FLOPS) rather than teraFLOPS.

Super Commodities

Nowadays almost all parallel computers are built from commercial off-the-shelf parts. They use commodity microprocessors like the Pentium or DEC Alpha in their compute nodes, commodity DRAM and SRAM for memory, and commodity RAID arrays for storage. Unfortunately for supercomputer designers, development in these different component areas is very uneven. In CPU and hard-drive design, progress is rapid; it's impossible to imagine any government research program that could deliver more spectacular results than the competition between Intel, AMD, Cyrix, and the RISC vendors has done.

While CPU speed increases by roughly 60 percent per year, the speed of DRAM increases by only 7 percent, which means that more than 60 percent of the transistors on modern CPU chips are squandered on caching logic, just to hide the memory latency. Worse still from the supercomputing viewpoint is that inter-CPU communication and operating system technology lag even further behind: The fastest commodity buses, like PCI, have nowhere near the performance required for a teraFLOPS, let alone a petaFLOPS, computer. Parallel-computer vendors have to be more concerned with ease of programming and software compatibility than absolute performance, so they'd rather settle around a group of commercial standards like PCI, Windows NT, and SMP clustering. The market for teraFLOPS computers is too small to tempt vendors away from this path.

Hence the ASCI PathForward Project, set up to give a selective push to those lagging technologies that are needed to attain 100 teraFLOPS by the year 2004. ASCI doesn't have the funds to design and build hardware from scratch, so it employs commodity components and contracts the services of companies like Intel and IBM to build machines, adding funding for extra effort in crucial integration technologies: hierarchical memory systems to reduce memory latency; high-speed, low-latency communication fabrics and parallel I/O systems; and scalable distributed operating systems and programming environments.

This ASCI work will be shared between the three U.S. national defense labs. The first machine, ASCI Red, is now running at Sandia. IBM is building ASCI Blue Pacific at Lawrence Livermore (see "PowerPC TeraFLOPS," page 76). And Cray/SGI is extending an existing machine at Los Alamos to become ASCI Blue Mountain.

A Pentium Punch

The ASCI Red machine at Sandia Labs is the world's biggest supercomputer, more than twice the size and speed of the second biggest (the CP-PACS at Japan's University of Tsukuba). ASCI Red is a distributed-memory parallel computer with 4500 compute nodes, contained in 79 cabinets that occupy 1600 square feet.

ASCI Red is built from four different kinds of nodes: Compute nodes are used solely to execute parallel application code; I/O nodes perform file and network services; system nodes are used to boot the machine and to run diagnostics; and

www.byte.com

Let Microway build your next Graphics Workstation, Personal Supercomputer or Server using...

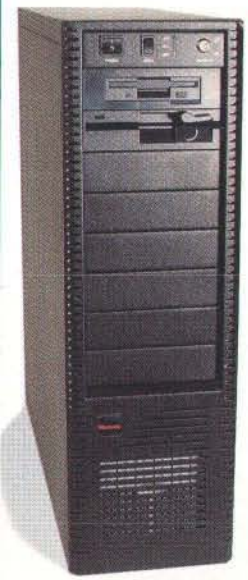
Screamer™ 600

Cray Performance at a PC Price!

600 MHz Alpha, 1.2 Gigaflops, 4MB Cache

Since 1982 Microway has provided the PC world with the fastest numeric devices and software available. No product in the last 15 years has excited us more than the Alpha Screamer. With its ability to execute 2 billion operations per second, the Screamer is the best choice for your next workstation or server! In addition to NT, the Screamer runs Digital UNIX and Linux.

Your applications can now run on "the fastest Windows NT machine on the planet." These include Microsoft Office, Oracle and Netscape; plus engineering and graphics software such as Pro/Engineer, Fortran, C/C++, Visual Basic, Microstation, ANSYS, LAPACK, Gaussian, Softimage and Lightwave. Over the last 15 years we have designed systems for thousands of satisfied customers worldwide, including prestigious institutions like NASA and Fidelity Investments. Our technicians are expert at configuring all Alpha operating systems and applications, and you will not find more technically competent sales people anywhere.



Custom Screamer Workstations

Microway systems include fast CPUs with equally fast caches, up to 2GB of high-speed memory and peripherals including SCSI hard drives, 3D graphics cards and RAID solutions. Microway's exclusive 4MB SSRAM cache, fed by a 144-bit wide memory system, boosts performance by up to 100%. Screamer™ workstations range in price from $1,895 to over $30,000.

Microway produces one of the finest numeric optimized compilers - NDP Fortran. Since 1986, hundreds of applications have been ported to the X86 with it. Using hand-coded BLA's and FFT's, our new NDP VDSP Library hits 343 megaflops triangularizing dense arrays and performs a 1024 complex FFT in 200 microseconds. This library also includes LAPACK.

AlphaPowered™

Press Accolades for Microway's Screamer

Windows Sources - February, 1998
"the Microway system blew away the best Intel-based workstations we've tested. . .on our number-crunching Lightwave 3D test."

LINUX Journal - January, 1998
"Literally everything runs profoundly faster on the Screamer."

PC Computing - July, 1997 ★★★★
Microway's Screamer . . . "is, quite simply, the fastest Windows NT machine on the planet. . . The performance leader."

Desktop Engineering - September, 1997 *Product of the Month*

Computers in Physics - September, 1997 *Product of the Month*

Visit **www.microway.com** for complete product information or call technical sales at **508-746-7341.**

Digital, Alpha, and Digital UNIX TM Digital.
Visual Basic, NT, Excel and Word TM Microsoft.
Screamer, NDP Fortran and Microway TM Microway.

Microway®

Technology You Can Count On

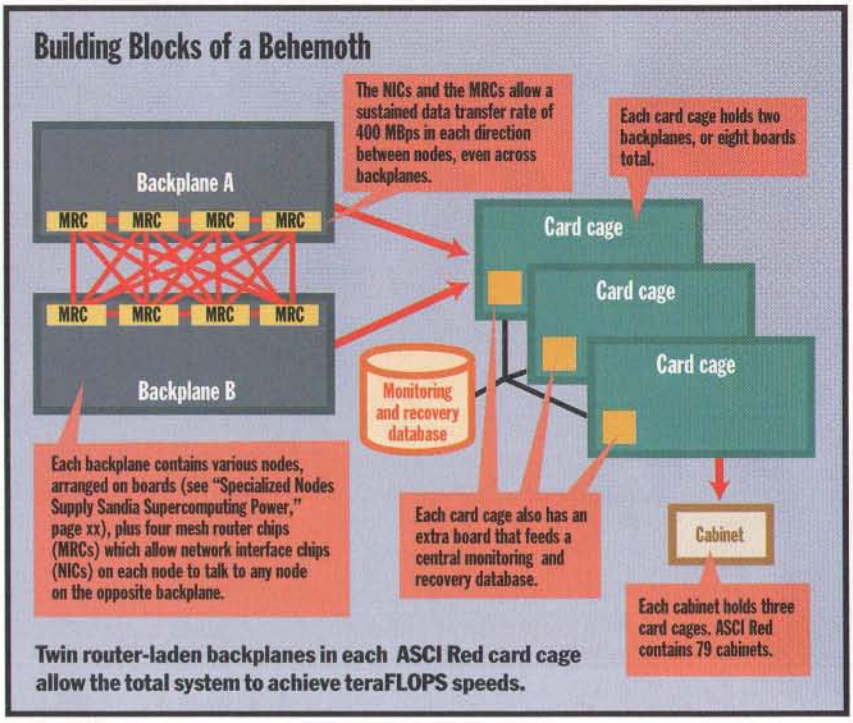
Corporate Headquarters: Research Park, Box 79, Kingston, MA 02364 USA • TEL 508-746-7341 • FAX 508-746-4678
www.microway.com, info@microway.com • Denmark 45 39624156 • Germany 49 6997650001 • India 91 806637770
Italy 39 290782776 • Japan 81 64593113 • Korea 82 25561257 • Poland 48 22487172 • Spain 34 35809444 • UK 44 1819446222

service nodes interact with the user and provide the front-end "host" system. All these types of nodes contain twin 200-MHz Pentium Pro CPUs (making a total of 9216 in the whole machine), plus several banks of interleaved DRAM (in standard SIMMs) on a custom-built 64-bit local processor bus. Compute nodes currently have 128 MB of memory each. I/O nodes also contain two 133-MBps PCI interfaces that can take Ultra-SCSI adapter cards for disk arrays, or ATM and FDDI network cards.

Two custom chips—the network interface chip (NIC) and the mesh router chip (MRC)—are the building blocks for the interconnect fabric of ASCI Red. The NIC provides a fast interface from the local memory bus to the MRC, which is a six-way switch, capable of routing messages at a sustained 400 MBps in each direction. Each of the MRC's six ports is divided into four virtual lanes, so that four independent message streams can pass through it at once (sharing the total bandwidth) to avoid contention bottlenecks. Every node contains one or two NICs, and the whole machine is based upon twin backplanes consisting of two-dimensional meshes of MRCs (see "Building Blocks of a Behemoth," at right). Using twin backplanes makes for better reliability, since the system can bypass a bad router by skipping across to the other plane and back (so-called *Z-X-Y-Z routing*).

ASCI Red runs two separate operating systems. The service, system, and I/O partitions all run Intel's distributed Unix (System V.3 with 4.3BSD Reno VSD extensions), which presents to users as a single Unix machine. The compute nodes each run a small operating system named Cougar. This OS is based on a microkernel called the Q-Kernel, which occupies less than half a megabyte and handles memory management, context switching, and message passing. Cougar performs low-level communication via *portals*, windows into a Unix process's address space. Portals exist in user address space, to avoid having to copy messages between kernel and user space, so they offer very low communication latency. ASCI Red's programmers will normally use a message-passing interface library built on top of this portal layer.

Reliability, availability, and serviceability (RAS) capabilities are crucial on a machine this size; whatever the individual mean time between failures (MTBF) rating of the components, when you have 10,000 of them, something is going to fail all the time. The RAS goal for ASCI Red is greater than four weeks of continuous operation with 97 percent of the resources available. The system contains redundant components, like 16 on-line spare compute nodes. All major



Twin router-laden backplanes in each ASCI Red card cage allow the total system to achieve teraFLOPS speeds.

PowerPC TeraFLOPS

IBM and Lawrence Livermore National Laboratory (LLNL) may take the PowerPC to near-teraFLOPS speeds this year, thanks to a new PowerPC chip.

The ASCI Blue Pacific "tech refresh," the second generation of LLNL's ASCI program, was scheduled to become operational in January. Unlike ASCI Red, ASCI Blue employs a four-way symmetric multiprocessing architecture, based on the Power PC 604e-X5 chip. This experimental IBM supercomputer can use message passing as well as shared memory parallelism, says Randy Christiansen, deputy ASCI program manager at LLNL.

While LLNL officials wouldn't say what speed this new IBM chip was running at, it can do two floating-point operations per cycle. The total peak capability of the system is 897 gigaFLOPS. With 320 compute nodes, and four times that many CPUs, the clock speed of the chips works out to about 332 MHz.

Each node on the system has 512 MB of RAM. There are also 16 disk I/O nodes built out of PowerPC 604 chips and 16 I/O-to-network nodes using older IBM Power SP2 chips. Similar to ASCI Red, the I/O nodes operate at about 800 MBps total. To keep costs low, ASCI Blue Pacific's designers avoid using custom chips, Christiansen says. Disk storage is 2.5 terabytes global, as well as another 2.3 TB of local storage, for a total of 4.8 TB of disk space.

LLNL plans to break through the teraFLOPS barrier at the end of 1998 by demonstrating its Sustained Stewardship TeraFLOP (SST) system. That system will be designed to scale up to a peak sustained rate of 3.2 teraFLOPS. LLNL and IBM will increase the number of symmetric multiprocessing nodes to 512 and also double each node to eight CPUs. The newest Power PC 630 chips, with copper interconnects, will be employed, and the supercomputer's central switch will itself be upgraded to increase transfer speed—to between one and 10 gigabits per second—and to reduce latency. Total memory will rise to 2.5 TB of RAM and approximately 75 TB of disk. Disk I/O will be between 1 and 10 gigabytes per second. LLNL hopes to have the system operational by the first quarter of 1999. **–Scott Mace**

The Definitive Reference Source!

BYTE on CD-ROM

Eight Years of BYTE — 1990 to Present
Plus, Quarterly Updates

Call +353-091-752792

or Order via the Web at

https: // www.byte.com/orders/subcd.htm

It's all at your fingertips — emerging trends, comprehensive world-wide industry analysis, multiplatform coverage of all the technologies, in-depth testing and product evaluations, advice, tips, expert opinions, and much more! It's a deal for anyone who's evaluating the significance of new technologies...doing research...making complex multi platform purchasing decisions...developing the next generation hardware or software products...preparing corporate plans.

It's Comprehensive... Time Saving...and Easy to Use! It's all in BYTE on CD-ROM.

English-language version only.
Available for Windows 3.1, NT, Win 95.

Order Now!

Toll-free International Numbers:

Belgium	080071635
Germany	0130826112
U.K.	0800973017
Italy	167876155
France	05916088
Netherlands	060222146
Switzerland	1557257
Denmark	80017728
Sweden	020791136
Other	
Int'l	091-752792
U.S./Canada	1-800-924-6621
FAX	353-091-752793

YES! I want the power and convenience of BYTE on CD-ROM.

❑ **Send me BYTE on CD-ROM *PLUS*!** The currently shipping version, *plus* 3 quarterly updates. 90+ issues for just **$54.95.**

❑ **Send me BYTE on CD-ROM!** Full text from Jan. 1990 through the end of the currently shipping quarter — over 90 issues for only **$39.95.**

Charge my: ❑ **Master Card** ❑ **VISA** ❑ **Amex** ❑ **Check enclosed** (Payable to BYTE magazine, US funds only)

Card # _____ Exp. Date _____ Signature _____

Name _____

Address _____

City _____ State/Province/Country _____ Zip/Postal Code _____

E-mail Address _____ PINTL

BYTE

Mail to: BYTE on CD-ROM, Post Office Box 72, Galway, Ireland

Canadian and U.S. orders, please add $2.95 for shipping and handling, and state tax where applicable. (Canadian orders add appropriate GST). Outside North America, add $5.00 for air mail delivery. Allow 6-8 weeks for delivery.

A Division of The McGraw-Hill Companies

components, including compute nodes, disks, and power supplies, are hot-swappable while the system is running and without powering down any other modules. To manage these RAS features, there's an active monitoring and recovery subsystem (MRS). Each card cage of eight node boards contains an extra board that monitors all the others, and these are all connected via dedicated RAS Ethernet (completely separate from the interconnect fabric) to a central MRS database that records the state of the units.

The Problematic PetaFLOPS

It will be far tougher to build a petaFLOPS machine, where interprocessor communications costs may swamp all other considerations. Researchers in various universities are currently working on technologies that may some day contribute to a petaFLOPS computer, and NASA has set up PetaFLOPS Enabling Technologies and Applications to coordinate this work. David Patterson, the inventor of RISC, is working at UC Berkeley on intelligent RAM (IRAM), which combines processor and memory onto a single chip to reduce the memory latency. Patterson reckons that such combined chips could reduce latency by a factor of 10. For a message-passing parallel architecture, there would still remain the question of communication between IRAMs. So it's likely that IRAM might be better employed to implement a "vector processor on a chip" with multiple arithmetic units plus memory, which could then be combined in clusters. Another research avenue takes the opposite approach—that is, to deepen the memory hierarchy rather than flatten it—by adding extra levels of caching and implementing more sophisticated dynamic caching and load-balancing algorithms.

Meanwhile, teraFLOPS power may pop up in many more places, such as helping routers scale up further. Each chip in an ASCI Red design could be reconfigured to act as a router, said Hank Zanini, of Avici Systems, at the Next-Generation Networks conference in November 1997.

Of course it's also possible that the teraFLOPS milestone may turn out to be an artifact of the Cold War that makes little economic sense in more peaceful times. This is certainly the view of Horst D. Simon, director of the National Energy Research Scientific Computing Center at Lawrence Berkeley, a major customer for high-performance computing (HPC) systems. "HPC is not a money-maker, so commercial companies have little incentive to innovate with radical new technology toward petaFLOPS," says Simon. "HPC technology is no longer 'hot' in U.S. research universities either, and there is no concerted federal petaFLOPS program. All these facts imply that HPC will follow an evolutionary growth curve, which will not lead to commercial petaFLOPS systems in the next 10 years." B

WHERE TO FIND

ASCI Blue Pacific Program http://www.llnl.gov/asci	**NASA's PETA Program** http://www.aero.hq.nasa.gov/hpcc/petaflops
Intel TeraFLOPS Program http://www.ssd.intel.com/tflop.html	**IRAM Research** http://iram.cs.berkeley.edu

Dick Pountain is a longtime BYTE contributing editor based in London. You can contact him at **dickp@bix.com.**

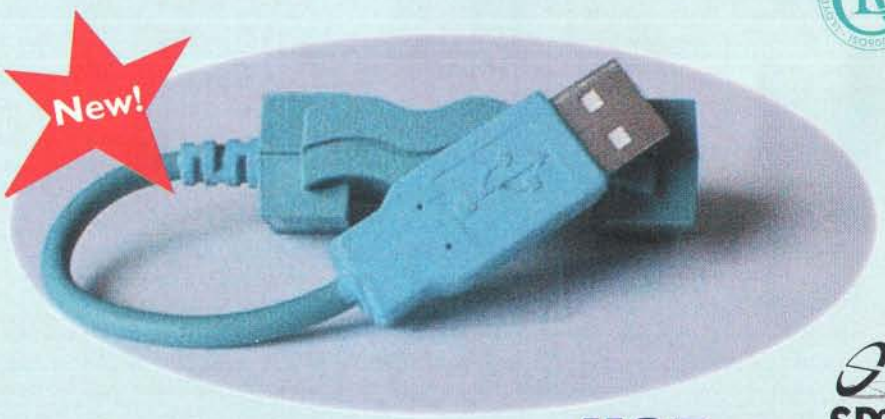
Enter HotBYTEs No. 114 at http://www.byte.com/hotbytes/

Next Generation Copy Protection

http://www.wibu.com
http://www.griftech.com

Customer Satisfaction Guaranteed

WIBU-SYSTEMS introduces the future of copy protection. The new WIBU-BOX/U combines the unmatched effectiveness of hardware based copy protection with the 100% trouble free operation of the Universal Serial Bus (USB), giving you and your cutomers something to cheer about.



USB

SD98 software DEVELOPMENT SAN FRANCISCO FEBRUARY 10th to 12th, 1998 Booth 1562

Call now for your free Test Kit:
(800) 986 6578

GRIFFIN TECHNOLOGIES

Argentina: Grupo Consultor S.A. · info@grupocsa.com.ar
Brasil: CASATK · casatk@netville.com.br
Denmark: DANBIT A/S · cahe@danbit.dk
France: NEOL S.A. · NEOL@compuserve.co
Spain/Portugal: DUBIT · www.dubit.pt

North and South America:
Griffin Technologies, LLC
1617 St. Andrews Drive, Lawrence, KS 66047
Tel. (785) 832-2070 · Fax. (785) 832-8787
Email: sales@griftech.com · www.griftech.com

Benelux.: COMPUSEC info@compusec.be
Croatia: ARIES d.o.o. Tel. +385-1-222752
Estonia: LanSoft Ltd. lansoft@infonet.ee
Japan: SUNCARLA Corp. fwid9705@mb.infoweb.or.jp

Germany and International
WIBU-SYSTEMS AG
Rueppurrer Strasse 54
D-76137 Karlsruhe
Tel.: +49-721-93172-0
Fax.: +49-721-93172-22
Email: info@wibu.com
http://www.wibu.com

WIBU SYSTEMS
Quality the World Trusts

Writing for Rhapsody

Apple's latest OS offers several rich application-development environments.

By Tom Thompson

Rhapsody—Apple's latest OS—offers a rich set of object-oriented frameworks for rapidly building GUI-based applications. These can range from complete cross-platform applications to Rhapsody-specific utilities that hide the messier details of configuring a server. This elegant melding of OS and development environments endows Rhapsody with the ability to both provide and manage industrial-strength server services by just pointing and clicking.

Rhapsody itself offers all of a modern OS's features: memory protection, preemptive multitasking, and threading. Its Unix-like services provide sophisticated OS features such as multiuser support and distributed file access. As such, Apple positions Rhapsody as a server and high-end user OS. But its development features set it apart from the crowd.

While Rhapsody may be starting fresh, it suffers from the same problem that has killed many an aspiring OS: few useful applications so far. You can translate this into: "How can I write programs for it?" Because Rhapsody is such a complex environment, the answer isn't simple. A closer look at the OS is necessary to understand why.

Both Old and New

Rhapsody's roots are surprisingly old. It began life a decade ago as NextStep, an object-oriented OS for the Next Computer (see "The Next Computer," November 1988 BYTE). Over the years, NextStep's object-oriented environment was ported to other systems, including Sun's Solaris, Hewlett-Packard's HP-UX, Windows 95, and Windows NT. In so doing, the OS achieved a level of portability that earned it the moniker OpenStep. Apple acquired Next in late 1996, and OpenStep became Rhapsody, the OS. Rhapsody also inherits what's best about the Mac OS: a simple yet powerful user interface (UI), plug-and-play hardware expansion, hot-swappable peripherals, and multimedia services such as QuickTime and QuickTime VR.

This tangled lineage actually confers two advantages on Rhapsody. First, the class libraries that implement many of Rhapsody's functions have been ported several times, which invariably exposes subtle code bugs. They have also been field-tested for years, which reveals more bugs. Thus, Rhapsody starts life with very robust and stable code.

Second, Rhapsody offers several application environments: BSD

ILLUSTRATION: 3VictoR GAD2 © 1998

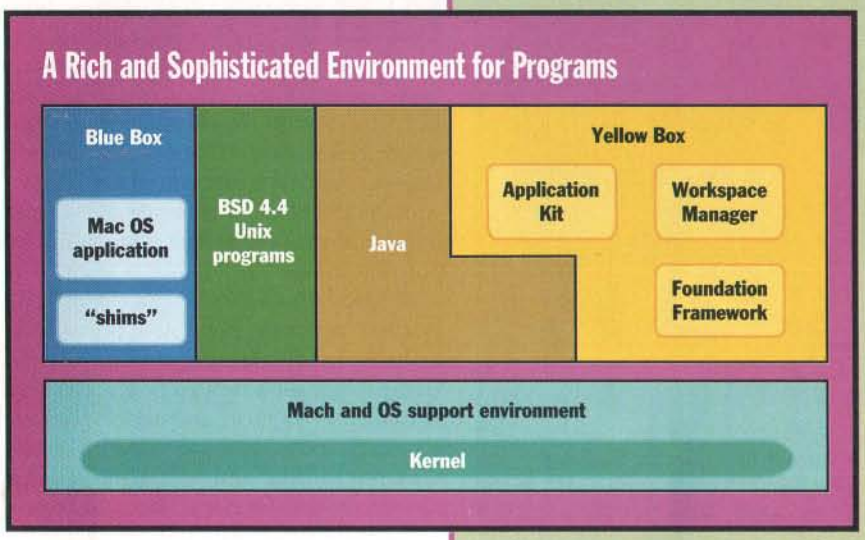
4.4 Unix, the Yellow Box application frameworks, and the Blue Box process that hosts the Mac OS (see the text box "Rhapsody Architecture"). Each environment offers a different way to write programs.

For Unix wizards, the BSD Unix emulation will be comfortable territory. Rhapsody literally provides a window into it: A Terminal application opens a console-style window, where you type Unix commands and write scripts. Typically, you use either telnet or FTP to transfer source code onto a Rhapsody system, edit it, and compile. An enhanced GNU 2.7.2 C compiler translates C, C++, and Objective-C programs directly into executable code.

Rhapsody Architecture

Like many modern OSes, Rhapsody has a kernel that implements most low-level functions, such as task creation. Higher-level services, such as file I/O, typically operate outside the kernel but make requests to it for resources. Rhapsody uses the Mach kernel, which was developed at Carnegie Mellon University, as a lightweight, communications-oriented kernel. It provides basic services such as tasking, interprocess communications (IPC), memory management, timing, and synchronization. Rhapsody's kernel is a port of Mach 2.0, with enhancements added by Apple, and releases 2.5 and later.

Another part of Mach, the OS support environment, manages networked IPC, distributed file access, and remote-execution services. It provides BSD Unix 4.4 emulation. In addition, Mach system calls are compatible with BSD 4.4 system calls, and Mach supports BSD 4.4 commands. After a simple recompile, BSD 4.4 Unix programs can run without modification under Mach.



A Mach kernel provides the base for Mac OS, Unix, Java, and Rhapsody-specific programs.

Apple plans for Rhapsody to host a 100 percent pure Java environment. The Commercial release will implement Java Beans, part of the Java Development Kit (JDK) 1.1 specification. Rhapsody supports JFC, IFC, AFC, and other Java class libraries, letting it run most Java programs.

At higher levels, Rhapsody provides the Yellow Box APIs, which are a set of OS-independent object-oriented frameworks. They are based on OpenStep 4.2 and are retooled with Apple enhancements. The Yellow Box provides a set of ready-made objects for managing the user interface (UI), drawing objects (via Display PostScript), handling text (using the Unicode 2.0 character set), and accessing system resources such as memory or disk I/O. If you need finer control over the display, the Yellow Box offers a set of graphics primitives that lets you manipulate the frame buffer. A Workspace Manager operates similar to the Mac OS Finder by placing a graphical interface over the BSD Unix emulation. It lets you view files or remote directories as icons or lists. The Workspace Manager also lets you launch programs and copy files by dragging and dropping icons.

Last but not least is the Blue Box. This is a preemptive Rhapsody process that hosts the Mac OS. Because it relies on a modified version of the Power Mac ROMs and the 680x0 emulator, the Blue Box runs only on PowerPC-based systems.

Rhapsody's OpenStep origins let it operate on different platforms. The OS is available on both PowerPC- and x86-based systems. The Yellow Box APIs operate on these systems and, with suitable run-time support, on systems running Windows NT.

Classy Classes

The Yellow Box APIs are a framework of object classes that implement various GUI elements, save/restore the state of your program, and access system services. Many of these objects have weathered the test of time. I wrote about their original incarnation nine years ago ("The Next Step," March 1989 BYTE). Then known as the Application Kit, this object framework consisted of 38 classes. Under Rhapsody today, the Application Kit has more than 100 classes. These objects provide application services that handle user events, draw to the screen, and manage the GUI.

A second framework, the Foundation Framework, provides a certain amount of OS independence. It also provides low-level services through some base utility classes and manages object persistence.

The major problem with the Yellow Box is that it's a whole new set of APIs to learn. However, there are some good reasons to do so. First, on PowerPC systems, the Yellow Box classes and the underlying OS are completely native, which means that applications harness the processor's full power. Second, applications can use Unix features such as distributed processing and remote procedure calls (RPCs).

Finally, an application's potential reach is as large as the desktop computer market itself. That's because the Yellow Box frameworks can also be subclassed from Java, which lets Java programs seamlessly invoke them. Because every computer has some sort of Java virtual machine (VM), a Yellow Box application could run without recompilation on PowerPC- and x86-based computers running Rhapsody, several flavors of Unix, and Windows.

Resolving Resources

As a Mac developer, you're probably wondering how Rhapsody deals with Mac resources: bytes that describe a GUI element's appearance and screen location, encoded into a special format. For example, a MENU resource specifies a menu and data that says the menu has four selections, labeled File, Open, Save, and Quit.

Latitude's Sleight of Hand

Metrowerks' CodeWarrior Latitude is a set of libraries that implements many Mac OS APIs for Rhapsody, Sun's Solaris, or Silicon Graphics' IRIX. It supports over 1200 of the most common Mac OS calls, which Latitude routes to the appropriate low-level Unix calls. It uses a layered architecture that successively abstracts the details of the host Unix system while providing Mac OS services.

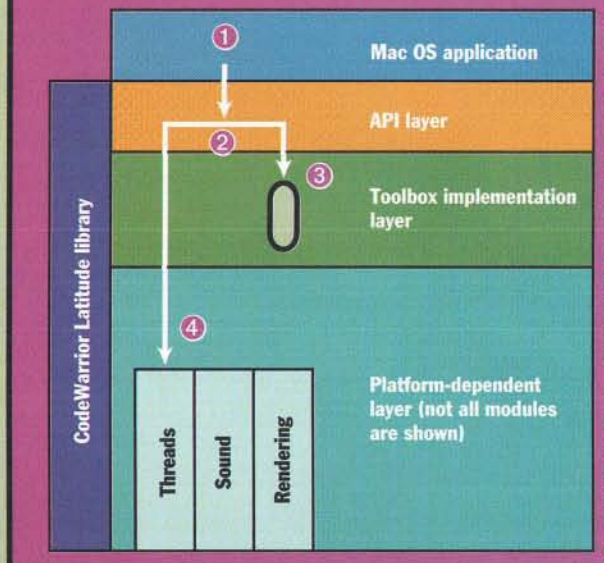
The topmost layer is the API layer, which presents the Mac OS interface to an application. The next layer is the Toolbox implementation layer. It uses platform-independent code that either performs the requested service or calls a function within a platform-dependent module. The lowest layer is a set of platform-dependent modules. These modules handle groups of functions, such as sound generation or threads, that rely on hardware- or OS-specific features to perform the requested operation. For example, a Rendering module calls Display PostScript for Rhapsody; the Silicon Graphics version uses the X Window System. Latitude also performs housekeeping operations such as converting Mac OS file path names to Unix path names.

API layer calls use the same 680x0-processor A-trap exception mechanism to jump to the proper function in the Toolbox implementation layer, similar to what happens on Power Macs. This level of indirection guarantees that Mac applications that patch traps to add custom features will continue to run.

Adapting your program for Latitude requires a few tweaks to the source code. If you have functions written in 680x0 assembly language, you'll have to rewrite them in C. Next, you compile the program using the GNU C compiler for your target system and link in the Latitude libraries. Now the application can run on the target system, and its user interface (UI) inherits the look and feel of the native OS.

Latitude deals with Mac OS resources several ways. There's a conversion tool that translates a file's resource fork into a C data array for compilation. At run time, Latitude can also access resources placed into data files by Unix conversion utilities like AppleDouble.

How the Latitude Libraries Perform Their Magic



1. Recompiled application makes Mac OS call.
2. Latitude API layer uses jump table to vector calls to functions in Toolbox implementation layer.
3. Toolbox implementation layer performs desired operation for certain Mac OS calls.
4. Other calls are routed to modules in the platform-dependent layer that perform the operation using OS- and hardware-specific services.

Metrowerks' CodeWarrior Latitude routes Mac OS calls to Unix services.

Consequently, a Mac application file has two sections: a data fork that stores application data and a resource fork. The resource fork has the resources that store program code and the UI description.

Using resources for the application's graphic elements uncouples them from the program code. To change the size of a window, a button's name, or translate the File menu's selections into French, you modify only the resource's data, not the program code. While resources sound like objects, they're not. A special part of the OS known as the Resource Manager understands each resource format and uses their data to build a UI element onscreen. Customizing the behavior of, say, a button requires some intervention by the programmer, typically through calls inside the program.

With the Yellow Box, UI elements actually *are* objects. For example, a button uses the `NSButton` class, an object that contains the methods that know how to draw the button and emit a message when it's clicked on. If you want to customize an object's behavior, you simply write some code to override the required methods and let object inheritance supply the remaining capabilities.

You use Rhapsody's Interface Builder (IB) to quickly build and customize the application's graphic interface. It provides a set of objects (e.g., a button, a dialog box, or a window) to choose from. You can change an element's size, color, and displayed name by just pointing and clicking. IB also lets you specify the message the element emits when acted on, and you can also select the target object that responds to the message.

This and other information is stored inside a Next Interface Builder (NIB) file, an archived object that's similar to a Java Bean. When an application loads a NIB file, the objects and their data are instantiated. NIB files are part of the regular file system—there's no resource fork. Rhapsody applications can be NIB directories that contain bit maps (e.g., file icons), the program code, and other NIB files.

Other Choices

While the Yellow Box has its merits, what do you do if you've already got some killer Mac OS application code? One choice is to link the code, with a little effort, to Metrowerks' CodeWarrior Latitude. (See the text box "Latitude's Sleight of Hand.")

Latitude lets you extend the reach of your Mac application to Rhapsody and other Unix platforms without drastically revamping existing code. It also lets the program take advantage of Yellow Box features, such as preemptive multitasking and memory protection, while still using the Mac OS APIs.

Rhapsody itself offers a course of action for those with lots of Mac OS binaries: You can take it with you. The Blue Box, as

mentioned previously, hosts a complete Mac OS environment within a Rhapsody process (see the text box "How the Blue Box Works"). The Blue Box consists of a Mac OS application that you can launch or have Rhapsody launch automatically.

When Mac OS application starts, you get the Mac OS start-up screen, followed by the dancing icons of Extensions loading. The Mac OS takes over the entire display, but you can toggle between the two

How the Blue Box Works

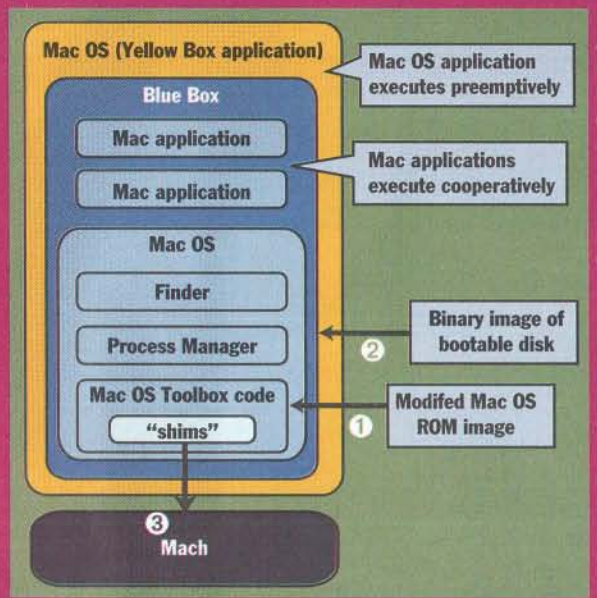
A Rhapsody program called Mac OS application manages the Blue Box. Mac OS application is actually a directory that contains Yellow Box Next Interface Builder (NIB) files, a Mac OS application, and a file that's a modified image of the Mac ROMs. The ROM image presents code "shims" to the Mac OS that prevent it from directly accessing the hardware. These shims are thin layers of code (to minimize a performance loss) that map Mac OS hardware calls to Unix software calls.

When the Mac OS application launches, it first loads this ROM image into memory and then "boots" from it. (Rhapsody never uses the computer's actual Mac ROMs.) The Yellow Box process next locates a binary image file of a Mac OS disk in /MacOSLibrary that contains a System folder. The process fetches code resources from this image's System file and a Blue Box enabler file. This latter file contains Rhapsody-compatible drivers that the unmodified Mac OS 8 code uses. Now, Rhapsody is running a preemptive process that is executing the Mac OS. Mac applications execute cooperatively, as before.

Importantly, the Blue Box runs native code most of the time, down to the drivers and Mach/BSD Unix calls, so its performance should be about as good as the Mac OS itself. (Recall that some of the Mac OS's low-level I/O code executes in a 680x0 emulator.)

Both the Blue Box and Rhapsody can share resources, because all Mac OS calls eventually wind up at the Rhapsody kernel. Currently, there's no conflict in accessing files, because the environments don't share disk volumes. For the Ethernet interface, its driver multiplexes Open Transport (Blue Box) Ethernet packets with Berkeley sockets (Rhapsody) packets.

Building the Virtual Mac



❶ When the Mac OS application launches, it reads a file of the Mac ROMs into memory and executes its bootstrap code.

❷ During the boot process, additional code resources and files (such as the Finder) are read into memory from a disk image file.

❸ When applications call the Mac OS, either Toolbox code executes or the call gets translated via shims into the proper Mach service call.

Rhapsody's Blue Box emulates a Mac OS environment.

Ultra2 SCSI is

Rhapsody Decisions

Decision	Pros	Cons
Writing to Yellow Box	APIs are based on NextStep, which has been out for over a decade and is thoroughly field-tested. By using Java, have the potential of the application running everywhere. While the initial market is small, it is the lucrative, high-profit server market.	Yet another API to learn, and for the Mac developer, there's no code compatibility.
Blue Box	Writing for the Mac OS lets you tap into a large mass market. Low-level Rhapsody services offer better concurrency and more stability.	Highly dependent on the integration of the Blue Box into Rhapsody. Has the same problems as the Mac OS: cooperative multitasking and little memory protection.
CodeWarrior Latitude	No new APIs to learn. Able to use existing Mac OS code to build applications for Rhapsody and Unix. Code exploits Rhapsody features (e.g., memory protection and scheduling).	Doesn't have the reach that using Yellow Box APIs would. Not all Mac OS calls are implemented.

environments easily. The Blue Box mounts all Mac HFS-formatted hard drives. It doesn't recognize any UFS drives or the Unix partitions that Rhapsody uses. AppleTalk works on the Ethernet interface, so you can use printers, run file sharing, or access AppleTalk servers. (The Blue Box implementation I tested didn't support TCP/IP directly: The protocol is encapsulated in AppleTalk packets, which must be sent to a gateway. Also, neither the serial port nor sound works.)

As you switch between Rhapsody and the Blue Box, you soon realize that the two environments are running separately from one another. Only a basic form of cut and paste for data is supported between the two. Hopefully, the situation will improve when both OSes support the Extended HFS format introduced with Mac OS 8.1, and the Yellow Box supports Apple Events.

I am very impressed with the Blue Box's capabilities. It loaded all my favorite Extensions and ran critical applications such as cc:Mail, Acrobat, Illustrator, Photoshop, PowerPoint, Word, and Excel without a hitch.

Apple still targets the Mac OS as a mass-market solution, and for a developer with limited resources and a successful product, sticking with the Blue Box makes sense. There's no risk on the developer's part, but there *are* long-term issues. It remains to be seen how well Apple can integrate the two environments. Part of what scuttled Copland was the difficulty of adding modern OS services while supporting the existing code base. If the Yellow Box and Blue Box applications can't seamlessly share data, such as via drag and drop, the future for Mac OS applications under Rhapsody will be problematic. B

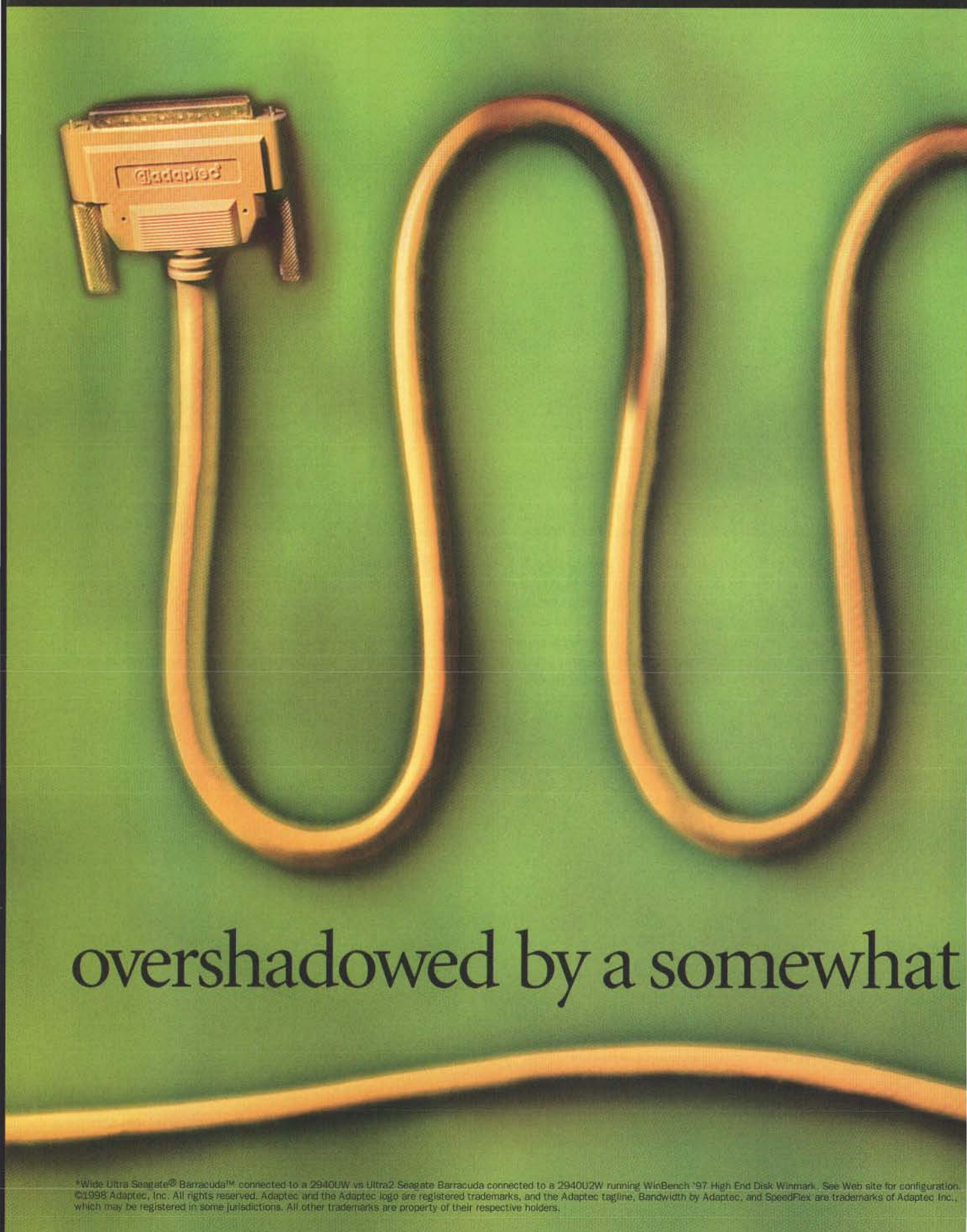
WHERE TO FIND

Apple Computer
Cupertino, CA
408-996-1010
http://www.apple.com

Metrowerks
Austin, TX
800-377-5416
http://www.metrowerks.com

*Tom Thompson (**tom_thompson@byte.com**) is a senior technical editor. He is the author of the book* PowerPC Programmer's Toolkit *(Hayden, 1996).*

twice as fast, but that may be

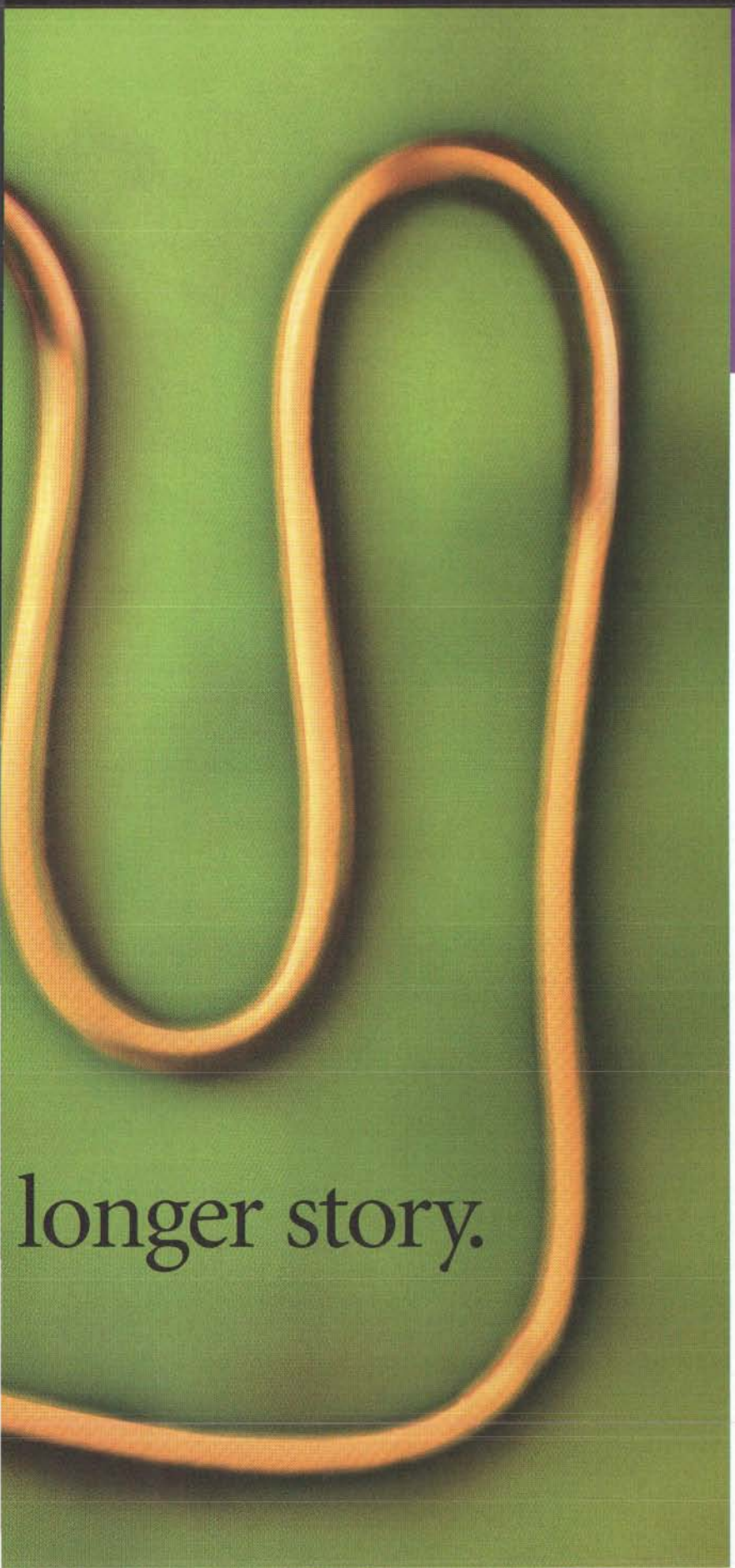


overshadowed by a somewhat

*Wide Ultra Seagate® Barracuda™ connected to a 2940UW vs Ultra2 Seagate Barracuda connected to a 2940U2W running WinBench '97 High End Disk Winmark. See Web site for configuration.

©1998 Adaptec, Inc. All rights reserved. Adaptec and the Adaptec logo are registered trademarks, and the Adaptec tagline, Bandwidth by Adaptec, and SpeedFlex are trademarks of Adaptec Inc., which may be registered in some jurisdictions. All other trademarks are property of their respective holders.

We move the information that moves your world.™ adaptec®

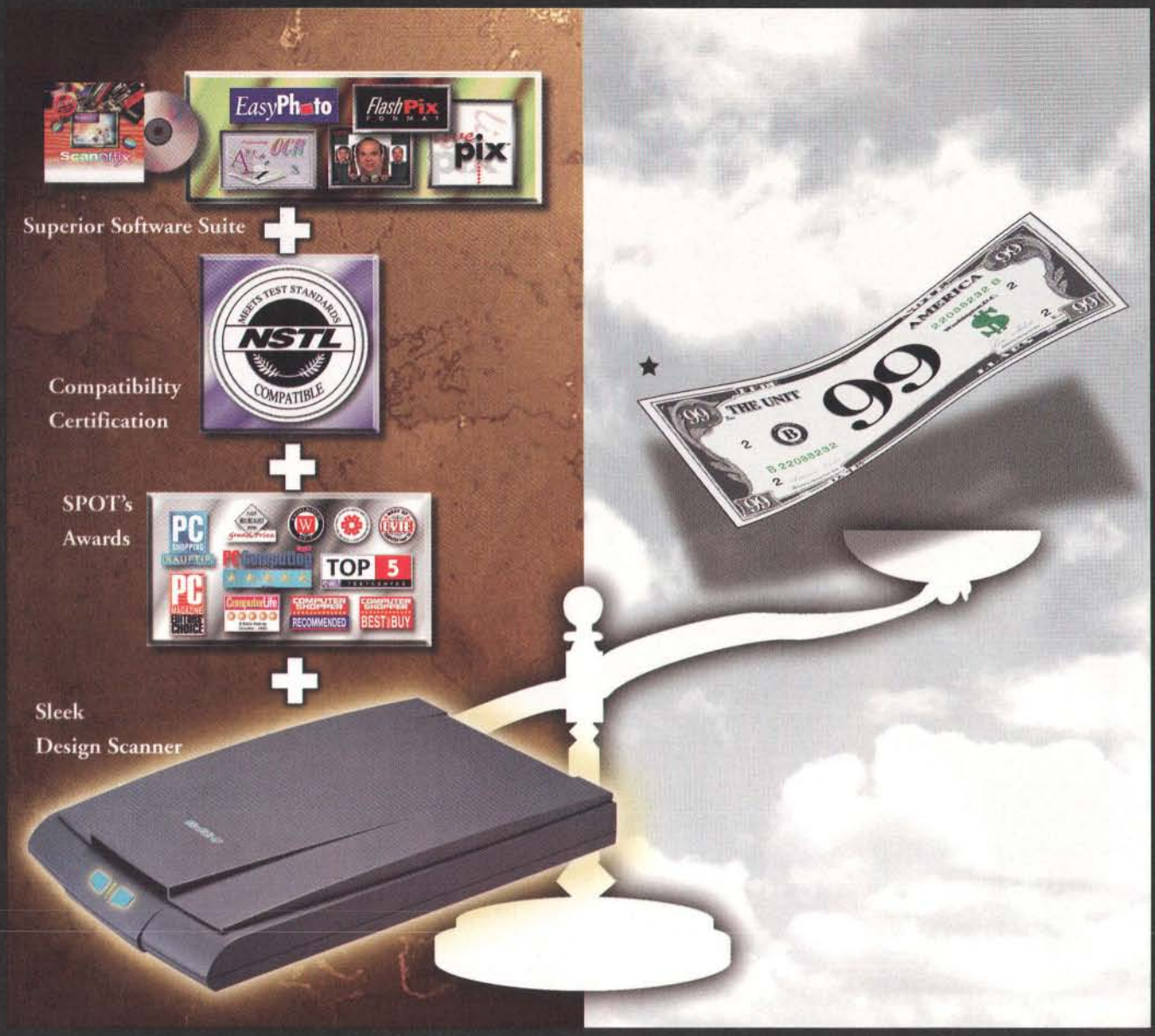


Everything you need is in the box.

SpecSCSI.

Up to 12 meters of cable. 4 times more than before. Not quite as exciting as doubling your burst rate from 40MB/sec. to 80MB/sec. Or boosting your overall system performance by 40% or more*. But if you're adding lots of drives or configuring clustered servers, that extra cable comes in pretty handy. And we made the transition to Ultra2 SCSI easy in other ways as well. While the kit includes all the cables you'll need for both legacy and Ultra2 devices, the card incorporates SpeedFlex™ technology, which makes Ultra2 SCSI completely backwards compatible. As always, the best way to increase performance is the simplest way. The Adaptec® way. Get trained on Ultra2 SCSI at www.GoSCSI.com/ultra2/byte. Or for product testing and evaluation information, call 1-800-804-8886 x9486.

BandWidth by ADAPTEC



★ Estimated street price

The definition of

Best Value

When you've got award - winning scanners coupled with an incredible software package, plug and play installation, fantastic after-sales service and amazingly low prices, you tip the scales of belief. This is what is known as Best Value: when we give you more of everything - quality, features, ease of use, service - for less of your money. The sooner you call the sooner we'll have you scanning.

SPOT™

The Smart Player of Technology

http://www.spotinc.com

e-mail: webmaster@spotinc.com

CeBIT 98 HANNOVER

Please see us at
Hall 9, B26 05
and Hall 12, C30

USB Interface Available!

SPOT INNOSCAN INC. North America
1-800-611 SPOT

SPOT Technology Co., LTD. Japan
3-3493-3588

SPOT Technology Inc. Taiwan
3-5878966

SPOT Technology UK LTD. UK
170-5322555

SPOT Electronics GmbH, Germany
2204-842950

SPOT Technology Inc. Canada
403-2433949

All brand names and trademarks are the property of their respective owners.

STORED PROCEDURES:

THREAT OR MENACE?

Stored procedures in database programming sure make it easy—to violate database rules, create inefficient code, and hinder portability.

By Joe Celko and Jackie Celko

Stored procedures are trouble in the making. Usually written in a procedural programming language (a third-generation language, or 3GL), stored procedures enable programmers to cast off the bonds of SQL and handle data sets as if they were data in sequential files. They can make database programming easier and database access faster, but in many ways they're not worth the trouble. Not only do they violate the theoretical rules of databases, they can be inefficient and make portability difficult.

True, stored procedures allow you to put a sequence of SQL statements into a single block of code and pass parameters to those statements. But for this type of use, you could instead replace a stored procedure with a simple batch file. Such a batch file might even offer some advantages, since it could also access other programs from its position at the OS level.

The real reason to use a stored procedure is to gain access to control structures and row-at-a-time access to database tables. But this is the seduction that leads to doom. Most programmers know how to write procedural code better than they know how to write tricky SQL. When they can't think of a simple way to solve a problem nonprocedurally, they go back to more familiar ways of doing things.

A Good Theory—in Theory

Theory is more practical than some younger programmers want to admit. Older programmers remember when Bohm and Jaccopini proved that you don't need to use a GOTO in a program and laid the foundations for modern structured programming. This is what the relational model did for modern databases.

When Dr. Codd wrote his list of the Twelve Rules for Relational Databases, he had some restrictions as to what a relational database could be like. (You can get Chris Date's version of the rules from *An Introduction to Database Systems*, Fifth Edition, pages 389 through 393, if you want to read them all.)

Rule zero (yes, there is a rule zero) says that "for a system to qualify as a relational database management system, that system must use its relational facilities (exclusively) to manage the database." That excludes a second (procedural) access method to the database from the start. In theory, this is not a handicap because anything that a procedural programming language can do, a nonprocedural language can also do. The proof and the definitions of this theorem are part of formal language and computability theory, which show you that it's possible, but not how to do it.

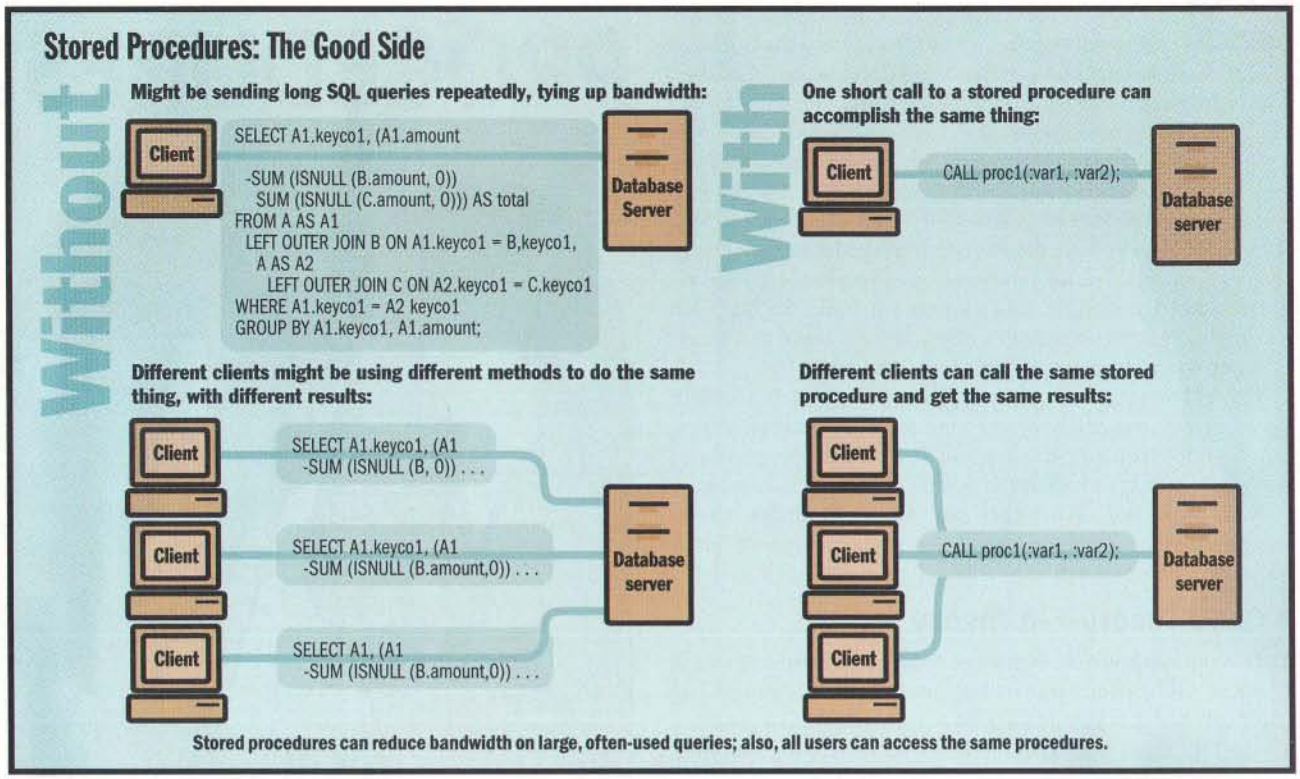
Rule two, the Guaranteed Access Rule, is essentially a restatement of the fundamental requirement for keys. In the relational model, every scalar value in a database must be logically addressable by specifying the name of the containing table, the name of the containing column, and the primary key value of the containing row. In a procedural model, on the other hand, you navigate a file by the position of the records that it contains. Then you find the fields within the record by their location. This does not require keys at all; you do this by either explicit or hidden cursors in the stored procedure language.

Rule 12, the Nonsubversion Rule, says that "if the system provides a low-level (record-at-a-time) interface, then that interface cannot be used to subvert the system," for example, bypassing a relational security or integrity constraint.

Fooling the Theory

In fairness, most SQL products are pretty good about rule 12 when they put data back into the database and apply all the con-

ILLUSTRATION: RICHARD DOWNS © 1998

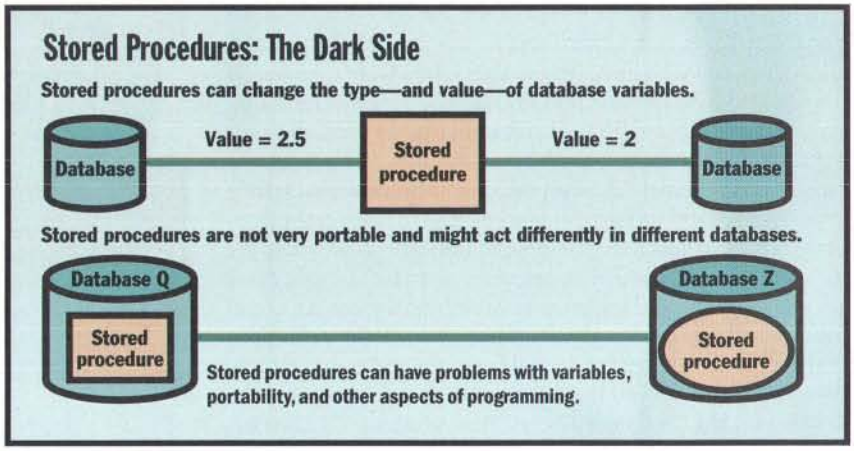


straints to it. The problem is that, more often than not, the stored procedure is working with local variables that have no constraints on them whatsoever and that can get their values from sources other than the database. This means that, even if the local variables come from the database initially, they need not represent anything in the database when they give the user information or return data to the database.

One simple example of this problem is loading a database value into a local variable that's of a different data type and nullability. You get a hidden automatic type conversion and the possibility of a different nullability (whether or not the variable can be NULL) from the original data.

This sort of error isn't even portable. Reading 2.50 into a local integer variable can give a value of either 2 or 3, depending on how the SQL engine treats rounding and truncation. Since the SQL standard leaves numeric-precision questions "implementation-defined," this practice is perfectly valid.

Correspondingly, using a local variable of a different data type and nullability to put data into a database can create type-conversion and nullability errors in the other direction. Integrity constraints prevent some errors, but not all of them.



Cursed Cursors

If you don't know exactly what a cursor is, think of it as a way of turning a SQL query into a simple sequential file. An updatable cursor must access only one row in the original table at a time. This leads to concurrency problems when someone else needs that row, too. The usual solution is to lock everyone else out of the table, and to heck with performance.

But this doesn't answer another question. If the cursor is on one row of a table and, in the same stored procedure as the cursor, an UPDATE statement updates all the rows in the table, does the data under the cursor also change? The answer varies from product to product, but it's always a surprise to the programmer who thinks a cursor should behave like a file.

Not Portable

The ISO has approved a SQL/PSM (Persistent Stored Module) language standard, based on Ada, that's better for use with SQL than with existing proprietary languages. It uses a block structure that can execute a statement group as a sequence (e.g., BEGIN...END) or as a unit (e.g., BEGIN ATOMIC...END), and it has the program flow-control statements needed for structured programming. A table can have

CDW®

DARE TO COMPARE

DESKTOPS

NOTEBOOKS

Acer

AcerPower Network Ready Series desktops

166/MMX 16MB 1GB	736.29
166/MMX 16MB 2.1GB	799.95
200/MMX 32MB 2.1GB	999.89
5/200 32MB 2.1GB	846.89

AST

Bravo LC Series desktops

166/MMX 16MB 2GB	879.59
200/MMX 32MB 2GB	1059.79
233/PII 32MB 2GB Win95	1189.79
233/PII 32MB 2GB WinNT	1686.22

Bravo MS Series desktops

166/MMX 16MB 2GB 16X	1299.85
166/MMX 32MB 3GB 16X	1389.78
200/MMX 32MB 3GB 16X	1388.59
233/MMX 32MB 3GB 16X	1639.65
266/PII 32MB 4.3GB 16X	1929.89

Bravo MS-T Series mini-towers

200/MMX 32MB 3GB 16X	1535.59
233/MMX 32MB 3GB 16X	1699.31
266/PII 32MB 4.3GB 16X	1949.59
300/PII 32MB 4.3GB 16X	2229.45

COMPAQ

Deskpro 2000 desktops

166/MMX 16MB 2.1GB	929.58
166/MMX 16MB 3.2GB	959.68
200/MMX 16MB 2.1GB	969.89
200/MMX 32MB 3.2GB	1135.49
233/MMX 32MB 3.2GB 16X	1479.89
233/PII 32MB 2.1GB	1496.67
233/PII 32MB 3.2GB 24X	1698.47
266/PII 32MB 3.2GB 24X	1898.76

Deskpro 2000 mini-towers

166/MMX 16MB 3.2GB 16X	1257.89
200/MMX 32MB 3.2GB 16X	1385.49
266/PII 32MB 3.2GB 24X	1948.27
300/PII 32MB 3.2GB 24X	2176.67

Deskpro 4000 desktops

166/MMX 16MB 2.4GB	1039.79
166/MMX 32MB 3.2GB	1269.68
200/MMX 32MB 2.4GB	1289.67
200/MMX 32MB 3.2GB	1338.59
233/MMX 32MB 3.2GB 16X	1598.49
233/PII 32MB 2.4GB	1666.87
233/PII 32MB 3.2GB 24X	1857.88
266/PII 32MB 3.2GB 24X	2258.69

COMPAQ

Deskpro 4000 mini-towers

166/MMX 32MB 3.2GB 16X	1489.49
233/PII 32MB 3.2GB 24X	1888.37
266/PII 32MB 3.2GB 24X	2288.68

Deskpro 4000N Network PCs

166/MMX 32MB 1.6GB	969.89
200/MMX 32MB 1.6GB	1119.79
233/MMX 32MB 2.1GB	1359.79

Deskpro 4000S desktops

166/MMX 16MB 2.1GB	946.77
200/MMX 16MB 2.1GB	1088.75
233/MMX 32MB 2.1GB	1368.89

Deskpro 6000 desktops

233/PII 32MB 2.1GB 24X	2327.87
266/PII 32MB 2.1GB 24X	2539.27
266/PII 32MB 4.3GB 24X	2847.67
300/PII 64MB 4.3GB 24X	3458.58

Deskpro 6000 mini-towers

266/PII 64MB 4.3GB 24X	3168.77
300/PII 32MB 4.3GB 24X	3488.87

Presario desktops

2200 5/180 16MB 1.6GB 8X	699.00

HEWLETT® PACKARD

HP Vectra VL Series 5 PC desktops

166/MMX 16MB 1.6GB	1039.89
166/MMX 16MB 2.5GB 24X	1135.85
166/MMX 32MB 2.5GB	1149.49
200/MMX 16MB 2.5GB	1129.98
200/MMX 32MB 2.5GB 24X	1368.59

HP Vectra VL Series 5 PC mini-towers

166/MMX 16MB 2.5GB 24X	1195.59
200/MMX 32MB 2.5GB	1277.89
200/MMX 32MB 2.5GB 24X	1329.89
233/MMX 32MB 4GB 24X	1509.89

HEWLETT® PACKARD

HP Brio Series mini-towers

166/MMX 16MB 2.1GB	887.76
200/MMX 16MB 2.1GB	917.45
233/MMX 32MB 3.2GB	1137.84
166/MMX 16MB 2.1GB 16X	1074.57
200/MMX 32MB 2.1GB 16X	1196.45
233/MMX 32MB 3.2GB 24X	1354.73

HP Brio Series towers

166/MMX 16MB 2.1GB 16X	1277.43
200/MMX 32MB 2.1GB 24X	1356.58
200/MMX 32MB 2.1GB 24X	1455.28
233/MMX 32MB 4GB 24X	1526.45
233/MMX 32MB 6GB 24X	1746.71

IBM Business Partner

PC 300GL Series desktops

166/MMX 16MB 2.5GB	939.05
166/MMX 32MB 2.5GB	1047.39
200/MMX 32MB 2.5GB	1109.89
200/MMX 32MB 2.5GB 16X	1269.95
233/MMX 32MB 2.5GB	1319.59

PC 300PL Series desktops

200/MMX 32MB 2.5GB	1339.75
200/MMX 32MB 4.2GB	1429.89
200/MMX 32MB 4.2GB 24X	1559.65
233/MMX 32MB 4.2GB	1599.89
233/MMX 32MB 4.2GB 24X	1729.96

PC 300PL Series mini-towers

166/MMX 32MB 2.5GB	1229.59
200/MMX 32MB 4.2GB 24X	1589.75
233/MMX 32MB 4.3GB 24X	2159.79

PC 300XL Series desktops

233/PII 32MB 2.5GB 16X	1889.75
233/PII 32MB 2.5GB	1699.75
266/PII 32MB 4.2GB 16X	2169.89
266/PII 32MB 4.3GB 16X	2519.68
266/PII 32MB 2.5GB	1949.69
300/PII 32MB 4.2GB 16X	2476.89

Deskpro 2000

COMPAQ

Model 6233X/2100

- 233MHz Intel Pentium® II processor
- 16MB SyncDRAM standard
- 2.1GB S.M.A.R.T. II Ultra ATA hard drive
- Integrated Matrox 1064 SG enhanced 64-bit graphics

Monitor sold separately

$1496.67
CDW 95916

17" color monitor

ViewSonic®

Model GS771

- 17" screen, 16" viewable image size
- Footprint of a 14" monitor
- 0.27mm dot pitch
- Resolution: 1280 x 1024 at 66Hz (maximum); 1024 x 768 at 87Hz (recommended)
- Advanced ARAG® screen treatment
- 3-year limited warranty

Now! "Short Depth" Design!

NEW!

$489.60
CDW 102833

Satellite Pro 440CDX

TOSHIBA

- 133MHz Intel Pentium® processor with MMX™ technology
- 16MB EDO RAM standard
- 1.34GB hard drive
- 10X CD-ROM drive
- 12.1" FastScan dual-scan color display

Price Drop!

$1588.46
CDW 90351

IBM ThinkPad® 380ED

IBM Business Partner

- 166MHz Intel Pentium® processor with MMX™ technology
- 16MB EDO RAM standard
- 2.1GB hard drive
- 20X CD-ROM drive
- 12.1" dual-scan SVGA color display

$1799.96
CDW 94542

TOSHIBA

Libretto mini-notebooks

50CT 5/75 16MB 772MB 6.1" AM	1399.98
70CT 120/MMX 16MB 1.5GB 6.1" AM	1949.87

Satellite & Satellite Pro notebooks

440CDX 133/MMX 16MB 1.34GB 12.1" DS 10X	1588.46
440CDT 133/MMX 16MB 1.34GB 12.1" AM 10X	1979.83
460CDX 166/MMX 32MB 2GB 12.1" DS 10X	1989.37
460CDT 166/MMX 32MB 2.02GB 12.1" AM 10X	2929.65
480CDT 233/MMX 32MB 3.8GB 12.1" AM 10X	3669.89

Portege notebooks

300CT 133/MMX 32MB 4GB 10.4" AM	2779.67
660CDT 5/150 16MB 1.2GB 11.3" AM 10X	2178.59

Tecra notebooks

520CDT 166/MMX 32MB 3.8GB 12.1" AM 10X	3129.17
530CDT 166/MMX 32MB 3.8GB 12.1" AM 10X	3379.67
730XCDT 150/MMX 16MB 2GB 12.1" AM 10X	2397.45
740CDT 166/MMX 16MB 3GB 13.3" AM 10X NT	3479.77
740CDT 166/MMX 16MB 3GB 13.3" AM 10X	3279.37
750CDT 233/MMX 32MB 4.7GB 13.3" AM 20X	4794.85
750CDM 133/MMX 32MB 4.77GB 13.3" AM 20X	4947.98
750DVD 233/MMX 64MB 4.77GB 13.3" AM DVD	5315.49

Acer

Extensa notebooks

391C 133/MMX 16MB 1.6GB 12.1" DS 20X	1689.58
392C 150/MMX 16MB 2.1GB 12.1" DS 20X	1879.85
391T 150/MMX 16MB 2.1GB 12.1" AM 20X	2379.87
392T 166/MMX 32MB 3GB 12.1" AM 20X	2799.87
670CDT 166/MMX 32MB 3.2GB 12.1" AM 14X	3279.97

TravelMate notebooks

7120T 200/MMX 32MB 3GB 12.1" AM 20X	3289.25
7130TE 233/MMX 32MB 3GB 13.3" AM 20X	3579.89

AST

Ascentia notebooks

M5130S 133/MMX 32MB 1.6GB 12.1" DS 20X	1899.89
M5160T 166/MMX 32MB 1.6GB 12.1" AM 20X	2739.89
M5160X 166/MMX 32MB 2.1GB 13.3" AM 20X	3329.88
M5200T 200/MMX 32MB 2.1GB 12.1" AM 20X	3329.45
M5230T 233/MMX 32MB 3.3GB 12.1" AM 20X	3789.47
M5230X 233/MMX 64MB 4GB 13.3" AM 20X	4649.89

COMPAQ

Armada notebooks

1530DM 133/MMX 16MB 1.4GB 12.1" DS 10X	1798.67
1540DM 150/MMX 16MB 2.1GB 12.1" DS 20X	2157.89
1550DMT 5/133 16MB 1.4GB 12.1" AM 10X	2089.79
1580DMT 150/MMX 16MB 2.1GB 12.1" AM 10X	2629.56
1590DMT 166/MMX 16MB 2.1GB 12.1" AM 20X	3078.85
4131T 5/133 16MB 1.4GB 12.1" AM	1648.96
4150 150/MMX 16MB 1.6GB 12.1" DS	2109.79
4160T SL 166/MMX 16MB 2GB 12.1" AM	2979.85
7330T 150/MMX 16MB 2.1GB 12.1" AM	1839.87
7350MT 166/MMX 32MB 2.1GB 12.1" AM	3259.66
7360DMT 200/MMX 32MB 3GB 12.1" AM	3715.47
7710MT 150/MMX 16MB 1.6GB 12.1" AM	1899.79
7730MT 166/MMX 32MB 2.1GB 12.1" AM	3279.65
7750MT 166/MMX 32MB 2.1GB 12.1" AM	3449.58
7770DMT 233/MMX 32MB 3GB 12.1" AM 20X	3699.89

Presario notebooks

166/MMX 16MB 2.1GB 12.1" DS 20X	2296.00
200/MMX 32MB 2.1GB 12.1" AM 20X	2996.00

HEWLETT® PACKARD

HP OmniBook 800 Series notebooks

800CT 166/MMX 16MB 2GB 10.4" AM	3679.68

HP OmniBook 5700 Series notebooks

150/MMX 16MB 1.86GB 12.1" AM	2798.22
166/MMX 16MB 1.86GB 12.1" AM	3059.23
166/MMX 16MB 1.86GB 12.1" AM	3059.23
166/MMX 32MB 2.79GB 12.1" AM	3669.71

IBM Business Partner

ThinkPad notebooks

380ED 166/MMX 16MB 2.1GB 12.1" DS 20X	1799.96
380ED 166/MMX 16MB 3GB 12.1" AM 20X	2699.87
560E 150/MMX 16MB 2.1GB 11.3" DS	1549.87
560E 166/MMX 16MB 2.1GB 12.1" AM	2897.67
560X 233/MMX 32MB 4GB 12.1" AM	3469.67
760XL 166/MMX 16MB 2.1GB 12.1" AM	3474.88
760XD 166/MMX 32MB 3GB 12.1" AM 8X	3839.77
765L 166/MMX 32MB 3GB 13.3" AM	3219.67
765D 166/MMX 32MB 3GB 13.3" AM 8X	3967.37
770 200/MMX 32MB 3.2GB 13.3" AM	3659.67
770 233/MMX 32MB 4GB 13.3" AM	4249.94
770 233/MMX 32MB 5.1GB 14.1" AM	4998.87

FUJITSU

LifeBook 500 Series notebooks

555Tx 150/MMX 16MB 2GB 12.1" AM 20X	2289.65
565Tx 166/MMX 32MB 2GB 12.1" AM 20X	2499.00
585Tx 233/MMX 32MB 4GB 12.1" AM 20X	3699.00

LifeBook 600 Series notebooks

656Tx 150/MMX 16MB 2GB 12.1" AM 16X	2799.00
675Tx 200/MMX 32MB 3.2GB 12.1" AM 20X	4239.43

LifeBook 700 Series notebooks

735Dx 133/MMX 16MB 1.6GB 12.1" DS 20X	1599.00
755Tx 150/MMX 32MB 2GB 12.1" AM 20X	2199.00
765Tx 166/MMX 32MB 3.2GB 12.1" AM 20X	2699.00

HITACHI

VisionBook Plus Series notebooks

4350x 150/MMX 16MB 2.1GB 12.1" DS 20X	1799.00
4360x 166/MMX 16MB 2.1GB 12.1" AM 10X	1999.00

VisionBook Pro Series notebooks

7360 166/MMX 32MB 2.1GB 12.1" AM 10X	2499.00
7560 166/MMX 32MB 3GB 13.3" AM 10X	2999.00
7580 233/MMX 32MB 3.2GB 13.3" AM 20X	4399.00

AMS Tech

Travel Pro 1000 Series notebooks

1960CT 166/MMX 16MB 2.1GB 12.1" AM 20X	2359.16
1960CS 166/MMX 16MB 2.1GB 12.1" DS 20X	1939.77

AMS Tech

1965CT 200/MMX 16MB 2.1GB 12.1" AM 10X	2399.98
1970CT 233/MMX 48MB 3.1GB 12.1" AM 20X	2879.13

Travel Pro 2000 Series notebooks

2010CX 166/MMX 32MB 2.1GB 13.3" AM 20X	2919.57
2020CX 200/MMX 32MB 2.1GB 13.3" AM 20X	2979.87
2030CX 200/MMX 48MB 3.1GB 13.3" AM 16X	3129.16
2040CX 233/MMX 80MB 3.1GB 13.3" AM 20X	3379.51
2035CX 233/MMX 32MB 3.1GB 13.3" AM 20X	3189.77

Rodeo 3000 Series notebooks

3000ECX 166/MMX 32MB 3.1GB 14.1" AM 20X	3429.84
3015ECX 233/MMX 32MB 2.1GB 14.1" AM 20X	3459.89

Rodeo 5000 Series notebooks

5000ECX 233/MMX 32MB 3.1GB 14.1" AM 20X	3756.67
5010ECX 233/MMX 64MB 3.1GB 14.1" AM 20X	4189.21
5020ECX 233/MMX 64MB 4GB 14.1" AM 20X	4439.87
5030ECX 266/MMX 64MB 4GB 14.1" AM 20X	4187.56

AM = active-matrix color display
DS = dual-scan color display

click here

CDW® compare

Find the right product right away! **http://compare.cdw.com**

For the most extensive selection of PCs anywhere, click on CDW® Compare!

CDW COMPUTER DISCOUNT WAREHOUSE

The right price.
The right advice.

800-959-4239 www.cdw.com

Check out the CDW® website for EVERYDAY giveaways!

©1998 CDW® Computer Centers, Inc. 200 N. Milwaukee Avenue, Vernon Hills, IL 60061 Byte 3551A 3/98

multiple attached triggers that can fire in order before, after, or instead of the triggering action.

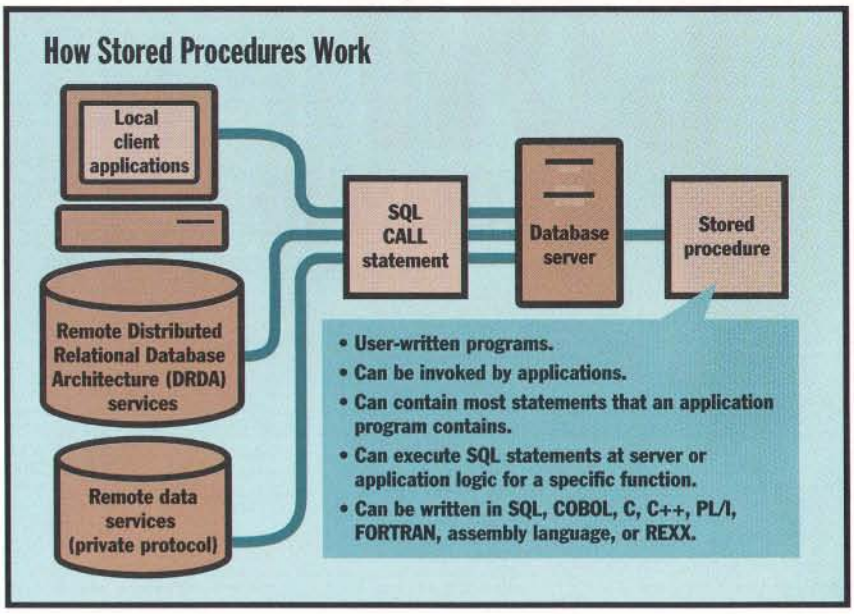
It's a nice standard, but only the Mimer database from Sweden has implemented it thus far. Most SQL products support triggers and/or stored procedures—each with its own proprietary language, which is usually based on an existing 3GL. Sybase/SQL Server's T-SQL language is based on C. Informix's fourth-generation language (4GL) is based on the ALGOL/Pascal language family.

But problems arise. An IF...THEN...ELSE statement, one of the fundamental building blocks of structured programming, uses two-valued, Boolean logic (i.e., TRUE, FALSE), while SQL uses three-valued logic (i.e., TRUE, FALSE, UNKNOWN). When a predicate in the IF clause returns UNKNOWN, should the THEN clause execute? The ELSE clause? Neither of them? SQL has no clear guidelines. UNKNOWN acts like FALSE in the WHERE clause of a SELECT, UPDATE, or DELETE statement, but like TRUE in the CHECK() constraint and other declarative referential integrity clauses.

Proprietary languages are just a minor problem in a one-vendor IS shop. However, such one-product shops are going the way of the dinosaurs. Modern IS shops have several different databases, usually as a migration-path plan for applications to scale up.

Software vendors who develop applications on many platforms and databases face this language problem on a daily basis. Their solution most often is to avoid writing proprietary script code for every database in their packages. Instead, they keep procedural code out of the database entirely and write procedures in C or another standard cross-platform language that can host SQL.

That's why ODBC, and now Java Database Connectivity (JDBC), are popular with developers of shrink-wrapped software. They permit you to link the object program (which the C source code containing SQL created) to a different backend library for each target database. The software vendor doesn't expose source code to the buyer and can maintain just one version of the source code.



Clients or remote processes can invoke stored procedures, programs that reside on the database server itself.

Let's Get Practical

4GL performance is several orders of magnitude worse than that of pure nonprocedural SQL. SQL database engines are optimized to handle large blocks of data on physical data pages in storage.

In addition, database-optimizing compilers are complex and sophisticated, while procedural languages have simple compilers. T-SQL is a classic example: It's a one-pass compiler that can't handle a forward reference and needs a @ in front of local variables. There's not much code optimization in a one-pass compiler; about all you can do is rearrange the expressions a little and hope for the best.

Procedural code is also much bigger than pure SQL. A SELECT...GROUP...BY...HAVING statement does the same work as over 100 lines of procedural code. The extra code is for error checking, opening or closing cursors, and so forth.

We once replaced a block of over 400 lines of T-SQL code with a few SQL statements. The pure SQL ran 2700 times faster. Anecdotal, perhaps, but indicative.

Also, many databases automatically recompile stored procedures whenever they are used—even several times in the same session. The system itself might cause this by paging a stored procedure out of main storage and not retaining the executable. A worse situation is when stored procedures call each other and push each other out of main storage, guaranteeing maximum compiling times.

Whoa, Trigger!

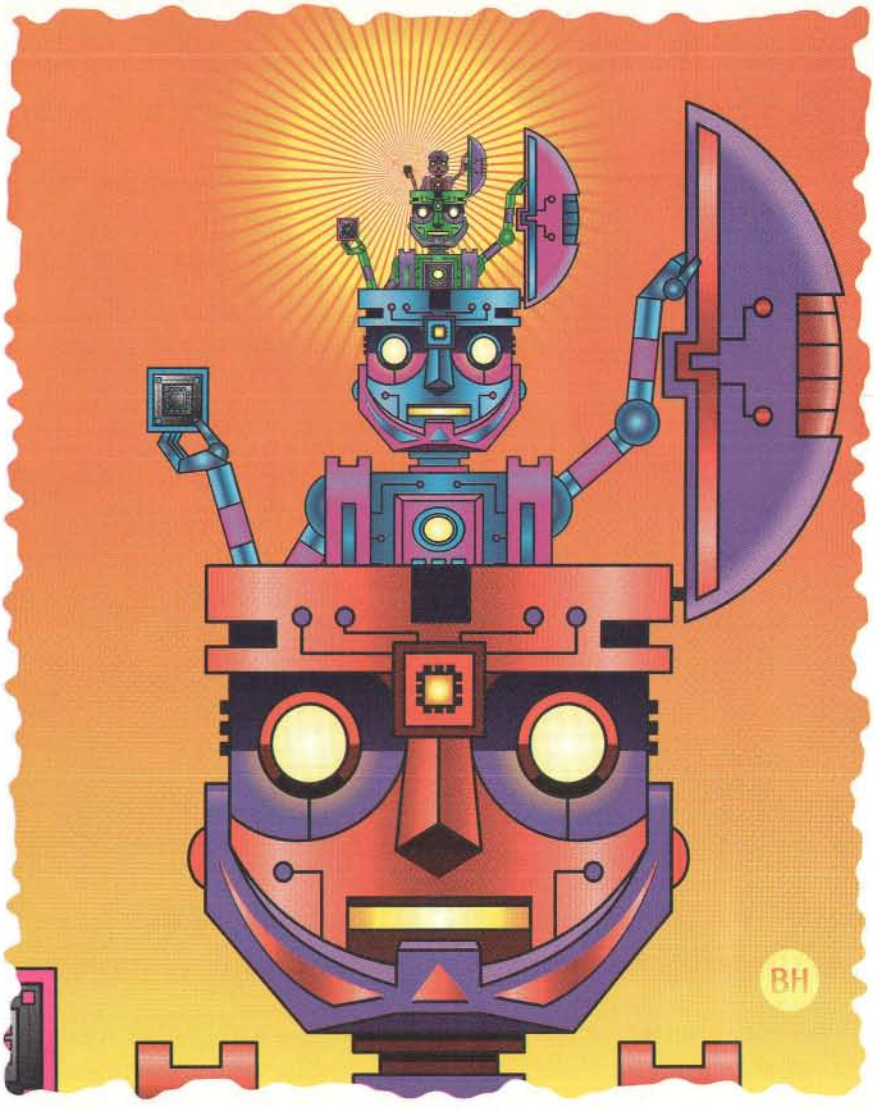
Another disadvantage is that triggers and stored procedures do not communicate anything to the query optimizer. The user calls the stored procedure, so the database has no idea when it will execute, or even what code it contains. If you maintain referential integrity with the PRIMARY KEY, FOREIGN KEY...REFERENCES, and CHECK() clauses on the tables instead of in triggers, then the optimizer can pick up the predicates in the CHECK() clauses and use them in its execution plan.

An advantage of many SQL databases is that a FOREIGN KEY...REFERENCES declarative referential integrity-constraint clause creates a special indexing structure inside the engine on the two tables involved and speeds up the joins on the primary and foreign keys. Stored procedures and triggers simply cannot do this, since they are added to schemata after the tables are created. B

Joe Celko and Jackie Celko are Atlanta-based technical writers. You can contact them at **1062.1056@compuserve.com.**

WHERE TO FIND

Informix Menlo Park, CA 800-331-1763 650-926-6300 http://www.informix.com	708-241-3500 http://www.mimer.com
Mimer Sysdeco Downers Grove, IL	**Sybase** Emeryville, CA 800-879-2273 510-922-3500 http://www.sybase.com



AMENDING MOORE'S LAW

For over 30 years, Moore's law has described exponential increases in chip power. Finance, technology, and physical law might change that.

By Dick Pountain

We've been living with Moore's law for 34 years now, so the idea that one day soon it might cease to apply could be hard to accept. Back in 1964, four years before cofounding Intel, Gordon Moore noticed that the number of transistors that could be squeezed onto a single chip was doubling every year. Those early chips contained a few thousand transistors, but once the semiconductor business got into its stride, the pace slackened a bit. The transistor count was doubling *only* every 18 months, and it's been doing that ever since.

Now the Intel Pentium Pro contains 5.5 million transistors, and the next-generation Merced will have closer to 10 million. What's more, as the number of transistors doubles, next-generation chips don't cost much more per unit to manufacture than the previous generation, so the cost per transistor is actually halved every 18 months.

As Luck Would Halve It

This halving of transistor costs happens because chips are fabricated using photolithography—in effect, a kind of printing process—so the economics work rather like print on paper. For instance, it would cost almost exactly the same for BYTE to print—with the same technology—twice as many words, at half the size, on this page, although destroying your vision is not in our mission statement.

Luckily, that problem doesn't arise with transistors, because a half-size transistor is just as good as its full-size predecessor. Actually, it's better, because smaller transistors are faster than big ones. For one thing, as the density of transistors on a chip rises, the distance between transistors is reduced, so the electrons don't have to travel as far (and, thus, they arrive sooner). Also, as you shrink CMOS transistors, you can switch them proportionally faster by raising the clock frequency. The power each transistor consumes remains the same.

The fortunes of Intel and other semiconductor giants have rested for nearly 20 years on this virtuous circle of physics. Smaller transistors mean more on each

ILLUSTRATION: BRAD HAMANN © 1998

chip, resulting in greater processing power and faster speeds. It's the reason that the 166-MHz Pentium machine I use today is hundreds of times more powerful than the single mainframe that served all of London University during my student days in the 1960s.

Every few years someone predicts the end of this exponential growth of chip density, but so far they've all been wrong. Now a slackening of the pace is in sight—not next year, but within the next decade. The reasons might be as much financial as they are technical.

You may have already spotted a weakness in my print-on-paper analogy. Printing twice the number of words on each page might not raise the cost per page, but the overhead would double from buying twice the amount of materials. Also, new technology might be necessary. Analogously, as chips get denser, the cost of designing them and the cost of fabrication equipment go up, too—perhaps not quite so fast, but following a similar exponential growth curve. An increasing number of industry commentators believe that it will be the cost of new fabrication plants, rather than technological obstacles, that causes Moore's curve to plateau.

Reproductive Problems

The current-generation Pentium Pro and PowerPC microprocessors use CMOS technology with a 0.35-micron feature size (roughly the size of each transistor and the metal tracks that connect them). The next versions of these chips, currently in sample production, will shrink to a 0.25-micron process. As Tom Thompson explains in "What's Next?" (April 1996 BYTE), these sizes are already pushing up against a technical barrier in the lithography process itself.

Physical law requires using a light with a wavelength smaller than or equal to the smallest feature of a chip to accurately copy the chip's layout masks onto silicon. Current litho machines use mercury arc light with a wavelength of 0.365 micron. Next-generation machines will move to exotic krypton/fluorine UV lasers that emit at 0.248 micron.

As chip fabricators try to reduce the feature size further, the illumination sources they need become ever more exotic, more expensive, and less manageable. UV lasers, plus optical tricks to enhance their resolution, are good down to about 0.1 micron. Below that, X rays are needed, and then things get *really* tricky. There is no method to focus X rays. That means you can't employ optical reduction, so chip masks must be the same size as the chip itself, making them terribly difficult to manufacture. Another difficulty is finding mask materials that are sufficiently opaque to X rays. Despite decades of research, X-ray lithography has never made a commercial chip.

Halve Mercy

Lithography is only the first obstacle. At feature sizes around 0.1 micron, problems with transistor threshold voltages, capacitance, and resistance in the metal in-

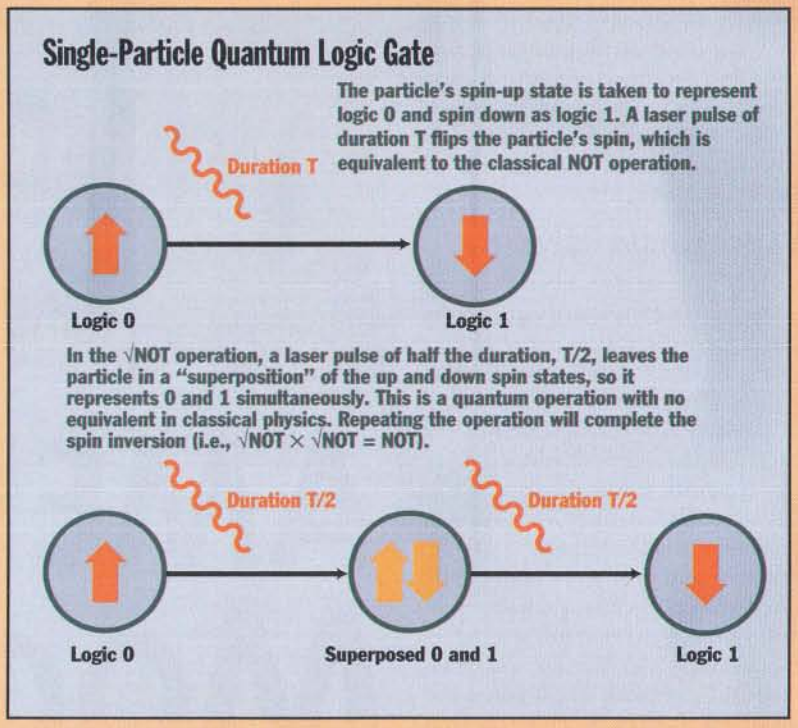
The Square Root of Not

To create a quantum computer based on binary logic, you need a quantum particle that has at least two states (a ground state and an excited state) and some means of forcing it to switch between the states. These states could be the spin of a single electron, electronic orbitals in an ion, or the magnetic dipole of an atomic nucleus. Corresponding switching agents could be pulses of laser light or microwaves.

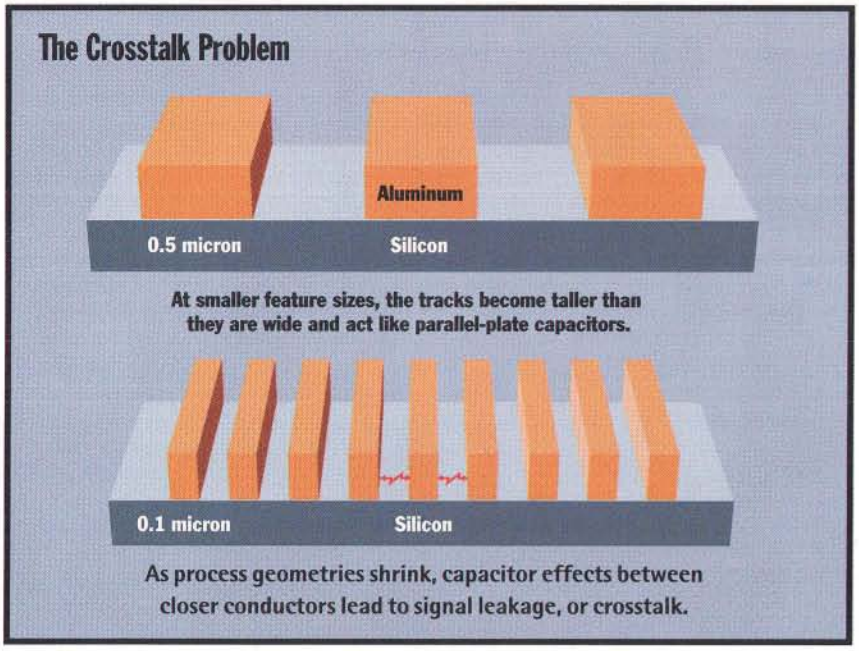
Designate one of the states (say, the ground state) as representing 0 and the other as 1, so the particle encodes the values of a classical digital bit. As shown in the top portion of the figure below, applying a switching pulse of duration p turns a 0 into a 1 (or vice versa), so the particle behaves as a Boolean NOT gate.

What makes a quantum gate different is what happens when you hit the particle with a pulse of $p/2$ duration. The particle's state now becomes a "coherent superposition" of both states; that is, it represents both 0 and 1 at the same time (see the bottom portion of the figure below). If you apply the $p/2$ pulse again, this superposed state collapses into the opposite of the original state.

David Deutsch christened this device the √NOT gate, because applying it twice in succession is equivalent to a single NOT operation (√NOT × √NOT = NOT). He also demonstrated that this is a universal operation (as are almost all quantum interactions), so you can perform any quantum computation by using a combination of them – just as you can use NAND gates to create any classical computation. Deutsch explains this situation in a more dramatic fashion: "Almost anything is a quantum computer if you shine the right kind of light on it."



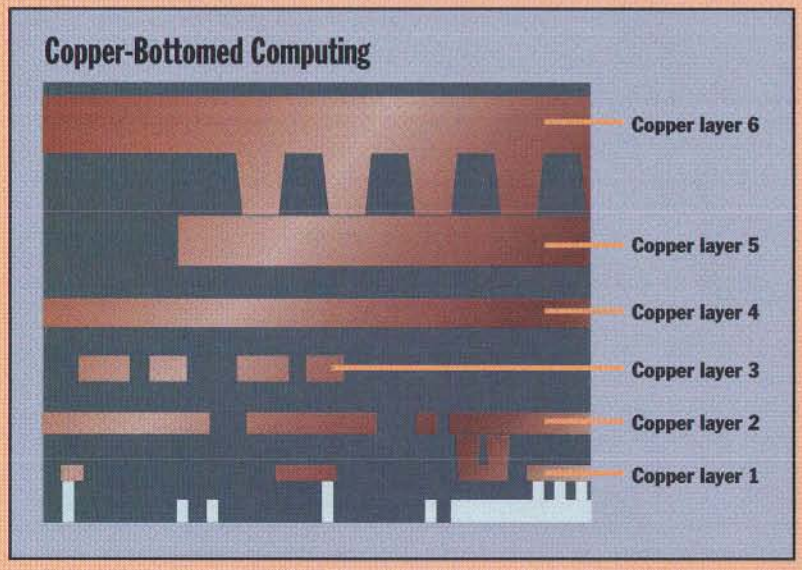
Single quantum particles can "remember" the previous state, so they can flip to the opposite logical state.



The Copper Connection

Last September, IBM announced that it had cracked the problems of copper metallization for its new CMOS 7S process (see the figure "Copper-Bottomed Computing" below). Manufacturers have long known that copper, a superior conductor, would be better than the aluminum currently used to make the tracks connecting transistors: Copper permits thinner tracks at the same resistance. However, aluminum is much easier to deposit by evaporation, and it sticks better to the silicon substrate.

IBM's CMOS 7S process will lead the market in several parameters (that is, until Intel catches up). Using six metal layers and a 0.2-micron feature size, it can pack 150 to 200 million transistors onto a die and operate at 1.8 V. IBM will be introducing ASICs built using CMOS 7S this year, and it will migrate the PowerPC chip to the process soon.



IBM has solved the problem of bonding copper to silicon, allowing the creation of tracks with superior conductance.

terconnects also hit crisis points. One benefit of CMOS is that—in contrast to competing technologies—transistors consume almost no current when they're turned off. This enables immensely complex chips, such as the Pentium, to have reasonable power consumption. As chip designs shrink, each individual transistor can run faster while consuming the same amount of power.

However, the total *number* of transistors per unit area increases by a square law, so the power consumed (and, hence, the heat dissipated) per unit area rises by a square law: half the feature size and quadruple the power per unit area. Fortunately, another property of CMOS technology comes to the rescue: The transistors' voltage and power consumption also relate by a square law. This means that lowering the supply voltage can compensate for this increased power consumption. Dropping from a 5-V operation to a 2-V one brings a sixfold power saving (52/22=25/4); dropping to 1 V would reduce power consumption 25-fold.

That's why chip designers have been reducing CPU core voltages over the past decade as feature sizes get smaller, by steps from 5 V, through 3.3 V and 2.8 V, down to 2.5 V, and even as small as 1.8 V for next-generation chips. As a result, we keep getting double the computing power for almost the same power consumption.

But in semiconductor design, the tradeoffs keep coming over the plate a little too fast. Unfortunately, reducing the supply voltage reduces the maximum clock rate for a chip by increasing the gate delay; the transistors switch slower. Fortunately, you can offset this by also reducing the transistor's *threshold* voltage (the voltage at which the transistors switch on). Unfortunately, if you lower the threshold voltage too far, the transistors won't work at all. But even before you reach that point, they begin to leak current, even when turned off.

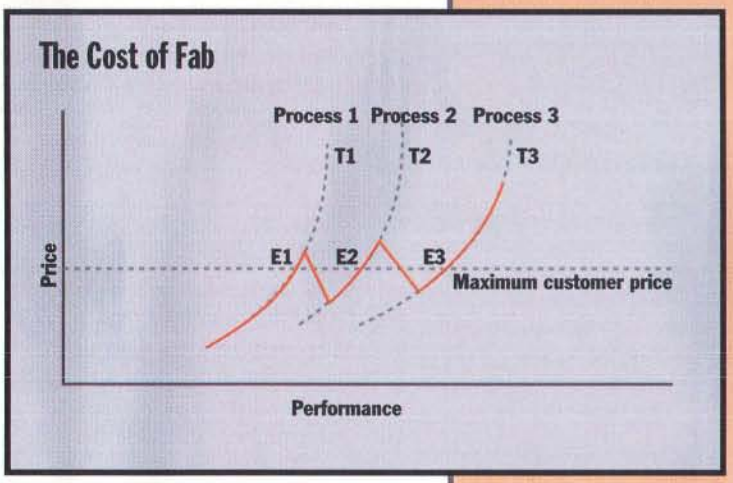
Steve Furber, professor of computing at Manchester University, is an authority on low-power chip architectures (he designed the original ARM chip). He describes the situation like this: "In standard bulk CMOS, for every 60 millivolts that you lower the threshold, leakage goes up by an order of magnitude. At the moment, the industry is lowering the supply voltage only as fast as it has to, to avoid transistor breakdown."

The bottom line of this mind-boggling

series of trade-offs is that just-under-1-V operation looks like a fundamental limit for CMOS technology. That's exactly where sub-0.1-micron chips are headed.

Crosstalk Act

Crosstalk is another gremlin that will make 0.1-micron features hard to achieve. Today's chips are essentially two-dimensional objects, so as you shrink them you have to cram everything closer together. The tracks that join the transistors must get narrower, but to avoid increasing their resistance too much, they still have to be relatively thick. Eventually they look more like walls than roads (see the figure "The Crosstalk Problem" on page 93). Worse, neighboring pairs of tracks start to behave as long, parallel plate capacitors, which slows down signal transmission and allows the signal on one track to leak into its neighbor (i.e., crosstalk).



Each new generation of a chip design has its own cost/performance curve.

Chip designers will be fighting an uphill battle against crosstalk. For example, the latest generation of CAD tools spaces the tracks farther apart than the minimum width. As Furber observes, "That's good for reducing crosstalk, but it starts to negate the advantage of the small feature size." One solution that promises to delay the inevitable is employing a better conductor, copper, so that these thick tracks can be made narrower. This will reduce intertrack capacitance (see the text box "The Copper Connection" on page 93).

The Everests of Chip-Making

Keeping up exponential growth beyond 0.1 micron will mean moving beyond the current universe of 2-D CMOS fabrication. There are hundreds of university research projects into 3-D chip structures and molecular-level transistors built from exotic organic polymers, but none of these technologies yet looks like a viable basis for such a huge industry.

The combination of all these difficulties might cause Moore's exponential curve to level off—at somewhere just below the 0.1-micron feature size, with more than 100 million transistors per chip, a 1-GHz clock rate, and 1-V operation—sometime during the next decade. According to Furber, "We've been blessed so far, in that the sorts of things ECL [emitter-coupled logic, as used in 1970's mainframes] board designers used to worry about—transmission-line effects, ringing, and so forth—have not existed in CMOS chips to any significant extent, but they're definitely coming." *continued*

Fab Forces Systems on a Chip

Business models, rather than technical obstacles, might halt the exponential growth in chip density. In 1981, G. Dan Hutcheson developed the nonlinear return on investment (ROI) model, which big semiconductor companies still use to guide their investment in plants and equipment.

He points out that price-based decisions, not technical obstacles, ultimately control chip life cycles. "The costs of achieving higher levels of chip performance rise very rapidly as the limits of a manufacturing technology are approached," he explains. "Increasing costs might drive prices beyond what buyers are willing to pay, causing the market to stagnate before the actual barriers are encountered."

In the figure "The Cost of Fab" above, the solid red line depicts the overall cost/performance history of a hypothetical chip family; the dotted curves show the cost/performance curves for successive generations. E1, E2, and E3 show the points at which the economics force the abandonment of the old technology, long before the technical "brick-wall" region (T1, T2, and T3) does.

Every peak in this cycle requires a new fabrication plant, the cost of which is rising about half as fast as Moore's law itself, doubling about every three years. Intel just spent $1.3 billion on its new fab in Arizona. Both Samsung and Siemens have paid $1.5 billion for new fabs.

You need to sell a lot of chips to recoup such investments, and eventually that won't be possible. Then you have to raise prices. Hutcheson says, "The semiconductor industry is not likely to come screeching to a halt anytime soon. When the cost per bit begins to rise permanently, the most likely result will be an industrial phase change that significantly alters business models."

Other industries experienced similar phase changes long ago. If this happened in the semiconductor business, big-iron chips, such as the Intel Merced, would remain expensive and change less often. Semiconductor firms would have to branch out horizontally, using spare silicon real estate to add more functions to a chip: Digital signal processors (DSPs), graphics accelerators, and eventually whole computer systems would be on one die.

There are signs that this is happening. Intel is rapidly diversifying into graphics, telephony, networking, and video. It has just reorganized itself and has finally conceded it needs to produce an inexpensive Pentium II for sub-$1000 PCs.

This is also a scenario that Robin Saxby, chairman and CEO of ARM, endorses. The firm has no fabrication facilities of its own; instead, it uses commercial foundries. Saxby sees the company's future in designing ASICs based around the ARM core, and eventually whole systems on a chip. "If you look at the motherboard of today's PC, you'll find devices from around 15 silicon vendors: a CPU from Intel, graphics from Chips & Technologies, a modem from Cirrus Logic, a sound chip from Yamaha," he explains. "The future PC 'motherboard' will be a single chip, but just one silicon vendor will supply that chip. The biggest challenge is getting the intellectual property for all those circuits to work together and connect."

ARM is one of 128 firms (including Alcatel, Fujitsu, IBM, Sony, and Toshiba) that have formed the Virtual Socket Interface Alliance (VSIA; http://www.vsi.org) to create standards for integrating such system-on-a-chip products by sharing and licensing the circuit components.

www.byte.com

Computer Associates Presents A Conference And Exposition Featuring The World's Leading Business Software Products And Experts.

The Fourth Annual

CA World 1998

April 26-May 1, 1998, New Orleans

10 User Conferences • 20,000 People • 6 Days • 1 Great City

1 World-Class Event

This is the world's premier technology conference attracting more than 20,000 clients from more than 40 countries and virtually every leading software and hardware company.

3,000 Technical Sessions

It's a learning extravaganza! Thousands of technical sessions to choose from that can upgrade your skills and enhance your resume.

Hot Jazz. Cool Apps.

100 FREE Industry Classes

These FREE education classes are priceless! It's a great opportunity to learn something new and upgrade your skills.

1 Incredible Jazz Festival

The hottest, hippest, oldest jazz festival in the world is happening the same week as CA-World. There will be all kinds of special opportunities for CA-World attendees to enjoy some world-class acts at the New Orleans Jazz and Heritage Festival.

250 Premier Technology Vendors

Virtually every leading hardware and software company exhibits at CA-World. In our mammoth, 300,000 square-foot World Resource Center, you'll have the opportunity to check out all the latest technology.

25 Industry Leaders

Just about everybody who's anybody comes to speak at CA-World. This year, come to hear Rt. Hon. John Major, former Prime Minister of Great Britain, Microsoft's Chairman and CEO, Bill Gates, and Compaq's President and CEO, Eckhard Pfeiffer, as well as CA Chairman and Chief Executive Officer, Charles B. Wang. Past speakers include President George Bush, Colin Powell, Bill Gates, and Scott McNealy.

1 World Pass To 10 Conferences

CA-World is the only event of its kind in the world! 10 different software conferences happening simultaneously! Your World Pass is your chance to attend different classes and events at any or all of them!

To Register CALL

1-800-CAINFO98

Or Visit Us On The Web At

www.caworld.com

COMPUTER ASSOCIATES®

Software superior by design.

©1997 Computer Associates International, Inc., Islandia, NY 11788-7000
All products referenced herein are trademarks of their respective companies.

New Version Released

PKZIP® for Windows

PKZIP® for Windows, the industry standard compression utility, has just gotten better.

PKZIP 2.60 for Windows includes these new features:

- Support for TAR, GZIP, MIME, BinHex, UUencoded & XXencoded file formats.
- Helpful Wizards to assist novice PKZIP users.
- Select a "List File" for adding a specified group of files at once to a .ZIP archive.
- Run an executable file from within an archive without the need to extract first.
- Create shortcuts for a .ZIP file on the desktop.
- Copy, move, delete & rename a .ZIP file from within PKZIP for Windows.
- Easily create new directories when unzipping files.
- Delete .ZIP files to the Windows 95 Recycle Bin.

PKZIP 2.60 for Windows is compatible with Windows 95, Windows NT and Windows 3.1x. PKZIP is also available for DOS, OS/2, SPARC Solaris and Open VMS.

http://www.pkware.com
info@pkware.com
414-354-8699

GENUINE PKZIP The Data Compression Experts PKWARE, Inc. Since 1985

PKWARE INC.
The Data Compression Experts

BY-398

The Semiconductor Industry Association's (SIA's) *National Technology Road Map for Semiconductors*, a collection of best-guess predictions from experts across the industry, agrees with this assessment. It hints at a slackening of the increase in clock speeds to around the 1-GHz level by the year 2010.

There are other obstacles besides CPU design. In DRAM fabrication, progress is slowing as cell sizes fall below 0.2 micron: Moving to expensive silicon-on-insulator technologies might be necessary to get past the 1-Gb level. Bus speeds currently lag five times behind CPU speeds (for example, a 300-MHz Pentium on a 66-MHz bus). This puts tremendous pressure on cache technologies to absorb the difference. A 1-GHz CPU will demand at least a 100-MHz bus. Intel already has motherboards in its labs running that fast, but such boards are hard to design and expensive to make, which may further upset the economics of the commodity PC market. But in a way, none of these technical obstacles is the real problem; it might be the business model that's in danger of topping out (for more information, see the text box "Fab Forces Systems on a Chip" on page 94).

Quantum Barrier or Bridge?

In addition to technology and finances, quantum mechanics presents a problem as well. At the 0.1-micron size, quantum effects start to become important. The electrons in the body of each transistor number only a few thousand, rather than billions. Ohm's law and other macroscopic rules that electrical engineers work by describe only the statistical average behavior of huge numbers of electrons. Once you start dealing with electrons on their own, they follow the very different laws of quantum mechanics. As Furber puts it, "The probability that a few hundred electrons will spontaneously migrate to the next transistor might be only zero-point-many-naughts percent, but given billions of transistors, in a chip that's expected to perform billions of operations per second without error for years, you'd eventually start to see that happen."

But what about the possibility of harnessing quantum effects to create a new kind of computer? Although many researchers are pursuing that goal, there aren't any working quantum computers as yet. Present experiments are still at the level of demonstrating one or two working quantum gates. However, the motivation that drives the search for a quantum computer is that it might solve classes of problems that will be forever denied to conventional computers.

Rather than operating on the bulk properties of electrons, as a "classical" digital computer does, a quantum computer operates at the level of single particles: atoms, ions, single electrons, or photons. Promising systems have beryllium or cesium atoms trapped inside resonant cavities, and quantum "dots": single electrons trapped in the energy wells at the junction of two layers of doped silicon.

Many experiments on quantum computing use lasers and mirrors—not because that's the way to invent practical devices, but because quantum optics is a well understood field. Which physical implementation eventually triumphs, if any, is not too important at this stage, however, as the principle underlying them all is the same, in a very profound sense (see the text box "The Square Root of Not" on page 92).

Quantum computers have a different range of usefulness than classical computers do. Also, in the opinion of David Deutsch of Oxford University, "They will probably never be used to add up accounts in banks."

Deutsch also doubts that quantum computers will ever be fabricated with the sort of large-scale integration that is seen in CMOS devices. As Deutsch says, "For classical computers, the difficulty has been making them smaller and faster. But for quantum computers, the difficulty will be to put more bits into the interactive region."

Exciting as quantum computers are in theory, they are not in a direct line of descent from MOS technologies. The same economics are unlikely to apply to their fabrication. In fact, these machines are likely to have to face their own equivalent to Moore's law. B

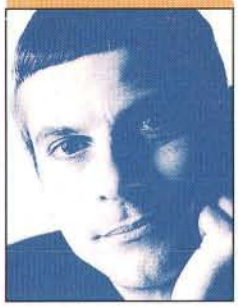
WHERE TO FIND

Intel
Santa Clara, CA
800-548-4725
408-765-8080
http://www.intel.com

Dick Pountain is a longtime BYTE contributing editor based in London. You can contact him at **dickp@bix.com**.

Jon Udell

Web Project



Perl and Apache

Apache's embedded Perl interpreter, mod_perl, powerfully integrates Web services with scripting.

Lots of people use Apache and Perl, but I've met only some who use mod_perl, Doug MacEachern's extraordinary synthesis of these two technologies.

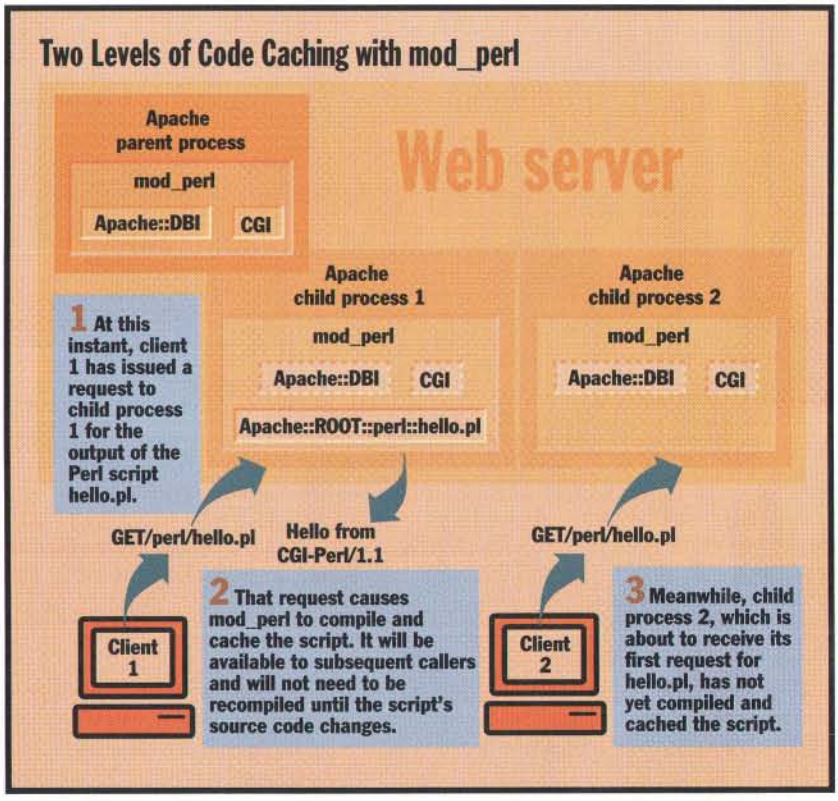
Why? Because mod_perl is, frankly, scarier than a typical Apache module. It doesn't just attach to one of Apache's module hooks, à la mod_auth or mod_rewrite. It can attach to all of them, so the Perl interpreter that it binds into the server can directly implement Apache extensions. It also exposes Apache's configuration and run-time data structures to Perl, so Perl code in the Apache configuration file or in conventional scripts can manipulate these structures. Plus, mod_perl isn't just "fast Perl for Apache"—although it is surely that, too. It's a deeply integrated Apache/Perl hybrid.

To use mod_perl effectively, Perl and Apache users alike need to acquire some new skills. The learning curve's a little steep, but the rewards are substantial.

An Introduction

I'll assume that you're running some flavor of Unix because, although an NT port of Apache is in the works, it's not quite ready for prime time yet. Begin by retrieving the latest recommended Perl distribution (see http://www.perl.com/). Build, install, and test Perl—that is: `./Configure`, `make`, `make test`, `make install`.

Now do the same for Apache (see http://www.apache.org/). Configure Apache to suit your taste—that is, edit the Configuration file so that it includes the modules you want—and then build (`./Configure`, `make`) and test (adjust settings in httpd.conf, run httpd, and point a browser at it). Now retrieve mod_perl (see http://www.perl.com/CPAN/). Here's the drill: `Perl Makefile.PL`, `make`, `make test` (this step requires the LWP module), `make install`.



Perl modules, such as Apache::DBI and CGI, can be compiled and cached at server start-up by means of the PerlModule directive.

The mod_perl make file, when invoked, will locate your Apache source tree and offer to create the new, Perl-ified httpd in that location. Don't forget to `make install` because, in addition to the new httpd, mod_perl comprises a set of Perl modules that must be added to your Perl installation.

If all went well, your Apache httpd is now much fatter. Should you worry? Admittedly, it's a concern. Since Apache, like most Unix Web servers, uses the flock-of-daemons approach to scalability—one master process and 10 or 20 or more children handling requests—the extra bulk of mod_perl multiplies accordingly. Throw lots of memory at the problem, and it will go away.

Alternatively, you can partition your Web application into dynamic parts that require the services of mod_perl, and static parts that don't. So, for example, a handful of mod_perl daemons listening on port 81 might serve the computation-

PHOTOGRAPH: KELLIE WALSH © 1998

al needs of a large flock of standard Apache (or other) httpds listening on port 80.

Next you'll want to try the mod_perl version of "Hello, world." Standard CGI Perl is governed by a line like the following in httpd.conf:

```
ScriptAlias /cgi-bin/ /cgi-bin
```

If the file /cgi-bin/hello.pl contains the following:

```
#!/usr/bin/perl print
"Content-type: text/html\n\n";
print "Hello from
$ENV{'GATEWAY_INTERFACE'}";
```

then invocation of the URL /cgi-bin/hello.pl from a browser will produce the phrase "Hello from CGI/1.1" on-screen. Behind the scenes, the Web server spawns a Perl process to achieve this effect. Eliminating that process-creation overhead is one of the major benefits of mod_perl. Here's the standard recommended setup in httpd.conf:

```
Alias /perl/ /perl

<Location /perl> SetHandler
  perl-script PerlHandler
Apache::Registry Options ExecCGI
  </Location>
```

This incantation names the directory /perl as a place where mod_perl scripts can live. And it establishes Registry.pm, a crucial Apache/Perl module, as the handler for Perl scripts that run from that directory. If you copy hello.pl to /perl and invoke it from a browser, the phrase "Hello from CGI-Perl/1.1" should appear.

Behind the scenes, things are quite different from the CGI example. The Web server does not need to spawn a Perl process to run this code because it already contains Perl. In this respect, mod_perl resembles Win32 ISAPI Perl. Both implementations are much quicker than conventional CGI Perl because the interpreter shares the Web server's process. However, mod_perl's performance edge goes beyond that of ISAPI Perl.

Two Kinds of Cached Compilations

An ISAPI Perl version of hello.pl is compiled once per invocation. So while Perl itself springs into action much more quickly than it would with conventional, out-of-process CGI, it must still do the work of compilation once per request. For a toy program like hello.pl, that work is negligible, but for real Perl programs with hundreds or thousands of lines of code, it becomes significant.

Consider CGI.pm, a very popular Perl module that offers a wealth of CGI-related services. You can use CGI.pm under ISAPI Perl, but you might not want to, because each time a client invokes a script that contains the statement `use CGI;` there is a perceptible delay as Perl compiles the module.

Can't CGI.pm's components be brought in individually? Yes, that's true, and it's often a good idea to selectively pull them in. But the fact remains that each component you use is compiled once per request.

With mod_perl's Registry.pm, CGI.pm compiles only once per httpd, and thereafter is instantly available to calling scripts.

BOOKNOTE

UML Toolkit

$49.99
by Hans-Erik Eriksson and Magnus Penker
Wiley Computer Publishing
http://www.wiley.com/compbooks/
ISBN 0-471-19161-2
UML, the Unified Modeling Language, defines a common approach to object-oriented modeling. This tutorial walks you through various UML design scenarios and includes a case study complete with a Java implementation.

How? Registry.pm conjures up its own Perl package, compiles your scripts into that package's namespace, time-stamps all the code, and recompiles only if the source files are newer than the compiled bytecodes.

Now for one of the interesting things about mod_perl that took me a while to get used to. Although you can use this compile-on-demand feature for a package like CGI.pm, you probably don't want to. Instead, you should use one of several httpd.conf directives to load CGI.pm when the server starts up. Here's one approach:

```
PerlScript /perl/startup.pl
```

This directive loads startup.pl when the server starts. If startup.pl contains `use CGI;`, it's compiled and made available to all subsequent scripts handled by mod_perl. Alternatively, you can do this:

```
PerlModule CGI
```

This directive names up to 10 Perl modules that should load at server startup.

Why not just let Registry.pm handle the caching of this code? It compiles into a unique package namespace that becomes cluttered and unwieldy if you pull lots of standard methods into it. There are two different code caches. The "startup" cache, loaded by the PerlScript and PerlModule directives, is immutable. If you change CGI.pm or another module, you need to restart Apache to propagate those changes to the mod_perl environment.

The "runtime" cache, maintained by Registry.pm, is, on the other hand, mutable. If you alter /hello.pl and rerun it, you will see the result of your change immediately. Registry.pm, noticing a newer source file, automatically updates the code cache. This occurs on demand once per Apache httpd—that is, each instance of Apache pays a one-time cost to recompile that script, and it does so only when the changed script is first invoked.

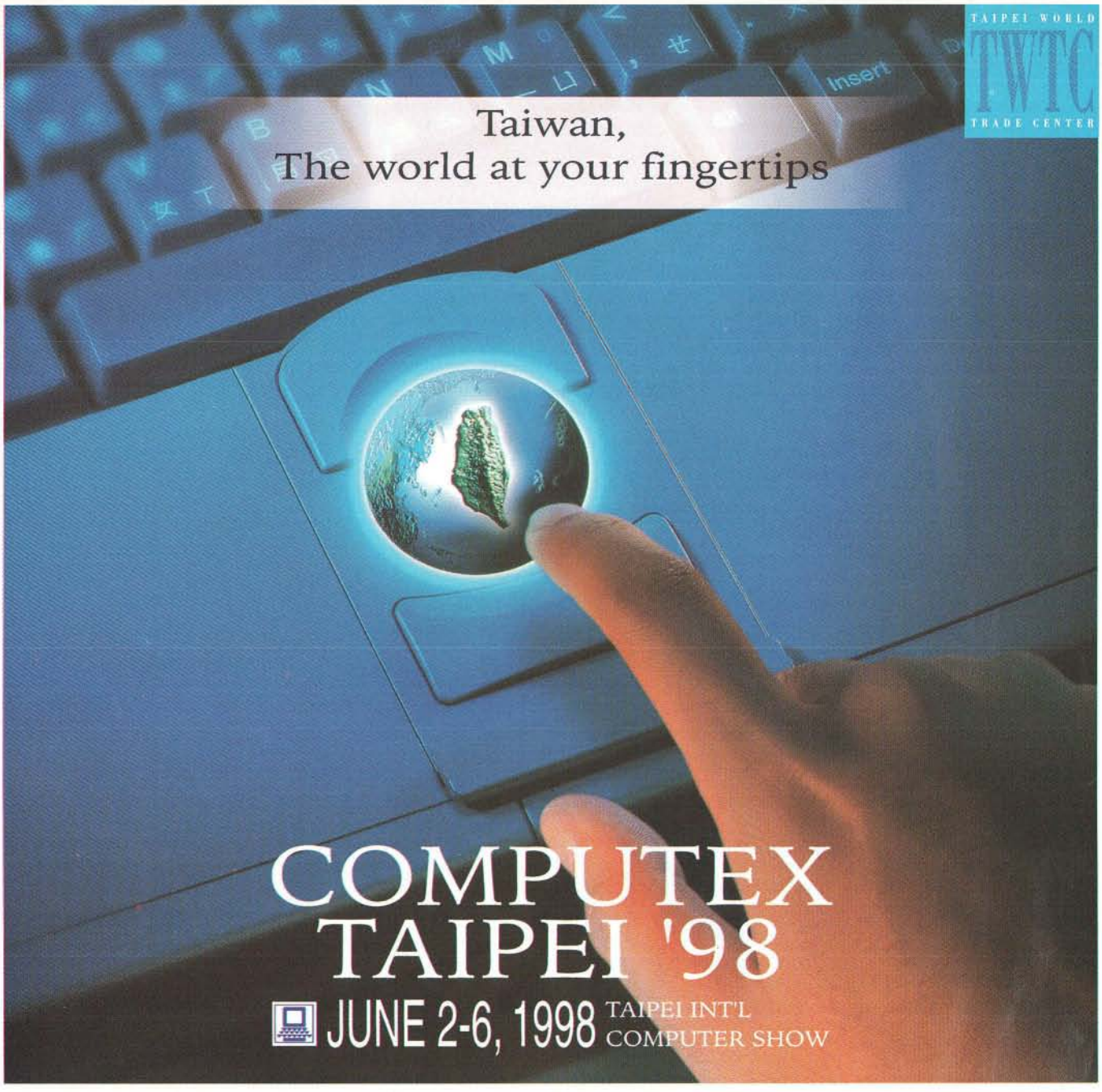
These two strategies are complementary. Per recommended Perl practice, I've divided a mod_perl application that I'm currently developing into a set of modules that export core services and a set of scripts that use those services. Because the modules change infrequently, it makes sense to compile them once at server startup. Because the scripts change often, it makes sense to compile them on demand using Registry.pm.

Avoiding Pitfalls

The cardinal rule of mod_perl is to preface every module and script with the statement `use strict;`. This oft-ignored tenet of good Perl practice will, among other things, prevent use of global variables.

Consider the difference between standard CGI-based Perl and mod_perl. In CGI Perl, the interpreter starts up, loads modules, runs a script, and then goes away. The whole Perl environment is transient. Even here you can get into trouble with global variables. Suppose a module opens a global `$DebugFile`. Then a script, expecting its own `$DebugFile`, does the same thing. If the module and the script intend to open different files, there's going to be a problem: The global variable is the same, and so is the file it represents.

With mod_perl, there is far greater danger. Each child process inherits the parent's global Perl namespace and then



It's the world's most dynamic industry and Taiwan is right at its center. Information Technology (IT) is the focus of *COMPUTEX TAIPEI* which is coming in June. Look for the next step in:

- Peripherals ranging from mainboards to monitors
- The hottest new notebooks
- Digital still cameras and scanners
- Dizzyingly fast CD-ROM drives

" If it belongs in or near a computer - you'll find it at *COMPUTEX TAIPEI '98* "

Featuring:

Desktop Systems
Notebooks
Monitor & Display
Multimedia Systems
Network Computing
Communications
PCMCIA Products
Peripherals
Imaging Systems
Mass Storage Devices
UNIX and Open Systems
Servers & Subservers
Sound & Video Boards
Components

Organizers:

China External Trade Development Council (CETRA)

5 Hsinyi Road, Sec. 5, Taipei, Taiwan, R.O.C.
Tel: 886-2-2725-1111 Fax: 886-2-2725-1314
http://www.computextaipei.org
E-mail: computex@cetra.org.tw

Taipei Computer Association (TCA)
http: //www.computex.com.tw

Sponsor:

Taipei World Trade Center

Official Carrier:

中華航空 CHINA AIRLINES

Venues:

Taipei World Trade Center Exhibition Hall (TWTC)
Taipei International Convention Center (TICC)

For more exhibition information, please contact CETRA.

Enter HotBYTEs No. 118 at http ://www.byte.com/hotbytes/

handles many transient scripts that can all scribble on that copy of the namespace.

It's true that the mod_perl environment is not actually immortal. Apache's `MaxRequestsPerChild` directive (default: 30) sets an upper bound on the lifetime of every httpd. Child processes that reach this limit expire and are replaced. This cleansing mechanism, intended to limit Apache's vulnerability to memory leaks, also forces a periodic flushing of the mod_perl environment. Nevertheless, the potential havoc that can be caused by contamination of Perl's global namespace makes the discipline of strictness well worthwhile.

Database Connection Caching, the Wrong Way

Inheritance of the master daemon's Perl namespace, though dangerous, has its uses. And mod_perl depends on this effect to make preloaded modules universally available to all children. It's tempting to try to cache handles to your own data this way. Here's a naive attempt to use a global variable as a persistent database handle:

```
use Fcntl; use SDBM_File;
tie(%myData,'SDBM_File','data',
  O_RDWR,0666);
```

This fragment uses Perl's `tie` facility to associate a DBM file (disk-based hash table) with the Perl hash table `%myData`. After this fragment executes, the statement

```
$myData{'Jon'} = 41;
```

does two things. It inserts the key `'Jon'` into an in-memory hash table, along with the value 41. And it synchronizes a permanent on-disk representation of the hash table with the transient in-memory table.

This is just standard Perl DBM practice. But suppose you include the tie construct in startup.pl and instruct mod_perl to run startup.pl when Apache starts:

```
PerlScript /perl/startup.pl
```

Now the global variable `%myData` is part of mod_perl's environment, available to scripts. For example, a script called lookup.pl could retrieve the value of `'Jon'` like this:

```
print $main::myData{'Jon'};
```

The tied hash variable looks like a kind of persistent database handle. Scripts running in any Apache child process can read, and even write, the keys and values of this database.

This scheme is incredibly fast. Unfortunately, it's also completely unreliable. And it's more fatally flawed than you might suspect. I thought at first that it would be safe to read values from the table but that some record-locking protocol (which most DBM implementations lack) would be needed in order to write values safely.

Wrong! Even reading is unsafe, as I learned from Rob Hartill, who develops the Internet Movie Database and contributes frequently to the Apache/Perl mailing list (modperl@listproc.itribe.net, archived at http://outside.organic.com/mail-archives/modperl/). Under heavy multiuser load, Rob says, reading the same key twice can produce different results. I tried a test myself by running many concurrent instances of a script that exhaustively read a tied hash. Read errors appeared, and they multiplied in proportion to the number of concurrent scripts.

How can this be? It's a consequence of the way Unix's fork mechanism works. It literally clones a process. If the instance of Perl in the master process has a file descriptor that governs access to a DBM file, children inherit that same file descriptor and can interfere with one another's positions in the file.

To safely read the same file from multiple children, you have to open the file once per child so that each child has its own independent file descriptor. The same rule applies to database connections. You could cache a database handle at server startup, but that wouldn't be very useful. What's needed is a way to cache a database handle once per child process. Happily, an indispensable module called Apache::DBI does exactly that.

TOOLWATCH

EventSLog

(shareware)
http://www.adiscon.com/
Mixed Unix/NT installations can now centralize system logs using this nifty tool that pumps NT's System, Application, and Security logs out to a Unix syslog daemon.

Database Connection Caching, the Right Way

Once you've eliminated the overhead of process start-up, by locating Perl inside Apache, the next key performance issue becomes fast database access. The holy grail of script-driven Web pages that fetch SQL data is to maintain a persistent connection between the script engine and the database. Here's how:

1 Install and test the DBI module (see http://www.perl.com/CPAN/).

2 Install and test the DBD driver for your database. Your test script should begin with `use DBI;` and then open a connection and read and write some data. When run from mod_perl, this test script issues a sequence of calls like this:

```
my $dbh = DBI->connect(....
$dbh->prepare(...
$dbh->execute(...
$dbh->disconnect(...
```

3 Install and test the Apache::DBI module. Now configure httpd.conf like so:

```
PerlModule Apache::DBI
Apache::DebugDBI
```

Then remove `use DBI` from the test script, restart Apache, and repeat the test several times. Apache's error log should look like this:

```
new connect to ...
already connected to...
```

Here's what's happening. Apache::DBI filters all DBI requests. Once per httpd, it honors `DBI->connect`. Subsequently, it hands callers a cached database handle. (`Apache::DebugDBI` produces the audit trail; you can turn it off as soon as you've proved that things are working.) Note that the persistent handle must be established in a run-time script, rather than a start-up script. Nothing prevents you from opening a handle in startup.pl, and that handle indeed persists and is visible to all child processes. But it's a per-server handle, which can't reliably be shared by multiple children.

Using mod_perl and Apache::DBI, I've prototyped a Perl application that does multiple database lookups behind each dynamically generated Web page without the slightest hint of delay. I've wondered whether it would really be possible to bring Perl's power and productivity to bear on major-league Web applications. The work of the Apache/Perl integration project has brightened the picture considerably. B

Jon Udell is BYTE's executive editor for new media. You can reach him by sending e-mail to **jon.udell@byte.com.**

www.byte.com

Rick Grehan

Javatalk

Object Marries Relational

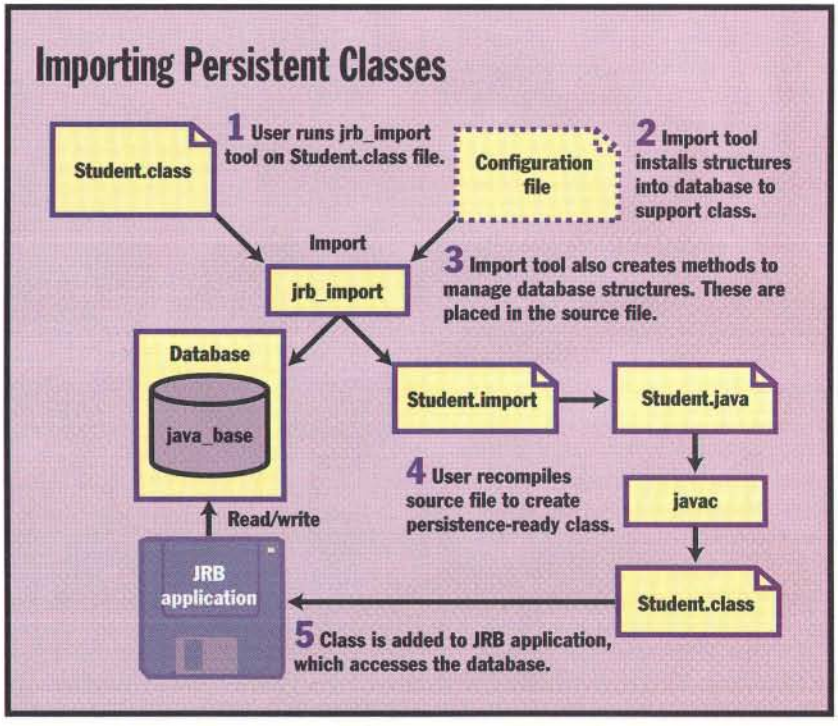
Ardent Software's JRB turns a relational database into a Java object-oriented database management system.

A truly unique entry into the growing cadre of Java-based object-oriented databases (which I've been looking at for the past three columns) is Ardent Software's Java Relational Binding (JRB). JRB's uniqueness is that it appears to implement an OO database, but it actually runs atop relational databases. The version I worked with is available in variations compatible with Oracle, Sybase, or any JDBC 1.2-compliant database package.

JRB is best described as a very thin object language binding between a JRB-compliant Java application and a relational database. With a relational database on the back end, it's reasonable to wonder how the multidimensional world of objects is mapped onto the two-dimensional world of tables and fields. The answer: The JRB run-time translates classes to tables; variables within a class become columns in the database. Object relationships (one object referring to another) are modeled using foreign keys. (Each object in the database is stored with a unique object ID, derived invisibly by JRB. These object IDs become the unique keys by which objects can be referred to—and therefore accessed—by other objects.)

JRB lets you store more than just classes in the database; you can also store Java bytecodes. Consequently, you can store a Java class wholesale in the database, and a JRB application can load the class at run time. The JRB API defines a `DatabaseClassLoader` class for doing this.

However, before your application can store any objects in a JRB-compliant database, you must first import the object's class into the database. You do this with the jrb_import tool, which reads the class definition (from a Java source file) and builds the necessary structures in the relational database.



Java Relational Binding uses an import tool (jrb_import) to process a class for use by a JRB application.

Any classes you intend on importing into a database must implement the `PersistentObject` interface, which defines the methods that JRB applications will ultimately use to store the objects in and retrieve them from the database. When you turn the jrb_import tool loose on the class to be imported, the tool creates a source-code file into which has been written the actual source code needed to manipulate objects of the imported class in the database.

Once you've imported a class into the database, you can begin storing objects in the database. Objects in a JRB application pass through several "states" as the application moves them in and out of the database. Objects can be transient, shadow, or persistent. A transient object is a "typical" Java object that your application has instantiated from some class. A persistent object is an object that has been stored in the database. (The JRB libraries include a variety of persistent classes from which you must derive all persistent objects.)

A shadow object is a partially loaded persistent object. That is, the shadow object has been instantiated, but its

PHOTOGRAPH: KELLIE WALSH © 1998

component variables have been initialized by JRB library routines with nulls or zeroes (depending on the variable type). Consequently, a shadow object is a persistent object that has merely been instantiated, and not loaded from the database.

As with the previous OO database systems I've reviewed, access to objects in a JRB database occurs within the bounds of a transaction. (An application can read objects from the database outside of a transaction, but updates and deletes are not allowed.) Shared modification of objects is dealt with through locks, and JRB provides three locking levels: shared, update, and exclusive. A JRB application will automatically acquire locks—in this case, shared locks—on objects accessed from within a transaction. A shared lock, therefore, serves as a kind of signal to other JRB applications accessing the same database that the object has been accessed from within a transaction. Placing a shared lock on an object, then, prevents the object from being modified by another application. Any number of applications can hold a shared lock on an object.

Next up the locking ladder is the update lock. Only one transaction at a time, and therefore only one application at a time, can hold an update lock on an object. However, an update lock does not exclude a shared lock. A JRB application will place an update lock on an object to signal its intent to modify that object.

To actually modify the object, the transaction must obtain an exclusive lock on the object. Only one transaction can hold an exclusive lock on the object, and an exclusive lock (as its name suggests) excludes all other locks.

JRB provides a number of avenues a developer can follow to fine-tune an application's performance along the lines of both execution speed and memory consumption. For example, objects that are read from a JRB database are loaded into a cache maintained by the JRB run-time. This improves performance in cases where an unmodified object is reread from the database. The system can simply draw the object out of cache rather than read it from disk. Ordinarily, this cache is invisible to the programmer. However, JRB does allow some limited manipulation of the cache from your application. You can, for example, explicitly delete objects from the cache, allowing the application to run in a smaller memory footprint.

Additionally, JRB includes methods that permit your application to load only a portion of an array object. This allows the application to consume smaller amounts of memory (since less memory is allocated to the array at any given time).

Also, you can fine-tune the database's space consumption on disk. For example, suppose you've declared a persistent class such that one of the member variables of the class is used for computation only. Since that variable is needed only at run time (and holds no persistent information), storing it in the database is simply wasting disk space. JRB lets you define the member variable as being transient. Transient member variables of persistent objects are not stored in the database and therefore do not waste storage space.

JRB is an interesting implementation of persistent OO technology. Because it consists of a thin Java run-time (most of the heavy work of lock resolution and transaction management is taken over by the back-end database), it is simple to set up and administer. A developer license for JRB is $500 ($1000 for a three-developer license). Contact the company for run-time license details.

Hard-core OO developers will also be interested in Ardent's full-blown OODBMS product, O2. A binding for O2 that is syntactically equivalent to JRB is available, allowing migration of applications from a relational back-end arrangement to the O2 full OODBMS. B

Rick Grehan (**rgrehan@austin.metrowerks.com**) *works for Metrowerks' Discover Products division. He is coauthor of* The Client/Server Toolkit *(NobleNet, 1996).*

Sun's Activator

One of the troubles that arises from dealing with the rapidly evolving Java specification is the existence of extinct species (read: versions) that will not die. Simply put, it would be great if everything were compatible with the latest version of the Java Development Kit (JDK), but everything isn't. Such is the raison d'etre of Sun's Activator.

Activator allows you to run JDK 1.1-compliant applets in browsers that are not JDK 1.1-compliant (i.e., browsers whose Java virtual machines [JVMs] are not JDK 1.1-compatible). At the time of this writing, Activator was available for Internet Explorer 3.02 or later. Activator for Netscape's Navigator 3.0 or later was expected by mid-January.

Activator relies on Microsoft's ActiveX /Component Object Model (COM) technology and Netscape's plug-in architecture to extend the capability of the browser to include JDK 1.1 support. Unfortunately for some of us, this arrangement requires a device-specific implementation for the hardware platform and, consequently, Macintosh users are left out in the cold for now.

Another consequence of Activator's modus operandi is that it does not replace the browser's existing JVM. Instead, you must specify explicitly in HTML that a particular applet is to run in the Java run-time environment (JRE).

Ordinarily, you use the `<applet` tag to embed a Java applet in an HTML document. An Activator-run applet, however is encased in what amounts to a JavaScript wrapper. In IE, this wrapper calls the Activator ActiveX control, passing to it as an argument the path to the Java applet .class file. Upon execution of the HTML page, the Activator control wakes up, loads the applet into the JRE, and—voilà!—the client sees a JDK 1.1-compliant applet.

What this means, of course, is that if you have piles of HTML files that you want to make Activator-ready, you're going to have to spelunk through them and modify all the applet tags. To make that task less arduous and error-prone, Sun has made available the HTML converter. Turn the converter loose on an HTML file and it will replace any instance of an `<applet` tag it finds with the JavaScript wrapper. It also places any applet parameters in their proper locations in the wrapper. (For the untrusting, the HTML converter keeps a backup copy of all converted files.)

There's one final consideration: On the client side, a user of an Activator-based Web page must first download the Activator control(or plug-in). Agreed, this is a one-time penalty, but it's a 2.8-MB-download-time penalty, during which time a user sees only a status message: "Installing components." (In addition, for IE at least, the client must have the security setting such that downloaded controls are allowed to run.) Time will tell if the citizens of the Internet world are willing to take that hit to be JDK 1.1.*x*-compliant.

WHERE TO FIND

Ardent Software
Westboro, MA
800-545-4545
303-294-0800
fax: 303-293-8880
http://objects.unidata.com

www.byte.com

Cosmo
Code 2.5

It's a third generation Java tool. But you've never seen anything like it.

It's a box. A tightly sealed, shrink-wrapped box of software open to anything a Java™ developer can dream up. A wish list fulfilled. A third generation tool created by Silicon Graphics and unleashed by Cosmo. An integrated set of powerful and highly visual tools for creating Java applications, applets, and classes. It's our response to your desire to maintain your code and your cool all at the same time. So unwrap it. Dive into it. Create sophisticated, cross-platform media rich applications. Blast through the entire development cycle, designing, debugging and delivering. Imagine everything. Stop at nothing.

But this is not some marketing inspired fantasy. Cosmo™ Code was built by the same engineers who created Silicon Graphics' award-winning ProDev™ Workshop and RapidApp.™ This is a mature, robust development environment that utilizes a proven code base. And this development tool includes class libraries from the leader in object oriented components—Rogue Wave® Software.

See for yourself. Call 1-888-91-COSMO ext. 282 or visit http://cosmo.sgi.com for more information on Cosmo Code 2.5. It's a product that has just what a Java developer needs. Everything you can imagine.

Now available on Windows® 95 and Windows NT.®

Put yourself in it.™

COSMO SOFTWARE
A SILICON GRAPHICS COMPANY

© 1997 Silicon Graphics, Inc. All rights reserved. Silicon Graphics is a registered trademark, Cosmo, the Cosmo logo, ProDev, RapidApp and Put yourself in it are trademarks of Silicon Graphics, Inc. Java is a trademark of Sun Microsystems, Inc. Rogue Wave is a registered trademark of Rogue Wave Software, Inc. Windows and Windows NT are registered trademarks of Microsoft Corporation.

Looking for your best career move?

BYTE JobNet

If you want nationwide exposure to hiring companies seeking quality Information Technology personnel, join the BYTE JobNet Registry today. BYTE JobNet is the most comprehensive Internet-based service ever developed for seasoned IT professionals who want to find the perfect job by managing their own job search. This is a ***free*** service to job seekers. Try it and see!

Hundreds of IT jobs! Find out instantly if you qualify!

Search the BYTE JobNet IT Job Bank.	Register online for *free!*	Create an updatable online resume.	Reply automatically to any jobs.	Manage your 'matching job' lookup.	Choose when to reveal your identity.

Special Bonus! AutoMatch™

When you register as a BYTE JobNet job seeker, we compare your online resume with every job ad in our IT Job Bank every day. When our search engine detects a match, you will automatically receive an E-mail from us with specific details on replying to the employer.

For a quick online tour of this ***free*** service to job seekers, click **BYTE JobNet Quick Tour** on our Web site.

www.BYTE.com/jobnet

A partnership with Elephant Online Information Technology Employment Matching Service

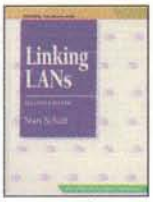
Technical recruiters: To become a new client of BYTE JobNet, E-mail sales@elephantonline.com, or call 1-800-632-7946.

Code: ITCG-B001

Stay Connected In The World Of Computer Technology

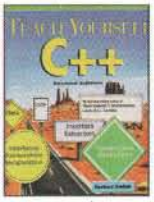
GET 5 Books FOR ONLY $4.95 when you join The Computer Book Club

Values to $261.88

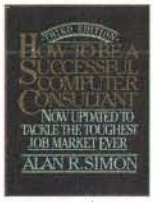


0570639 $45.00

8820812 $29.95

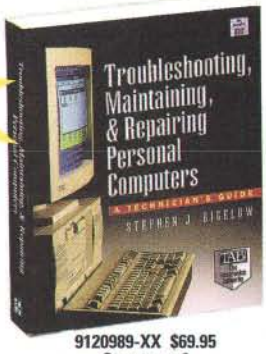


8820251 $24.95

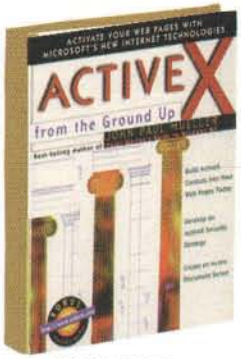


0580340 $30.00

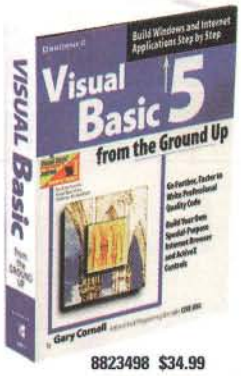
882138X $32.95



9120989-XX $69.95
Counts as 2



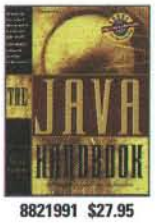
8822645 $29.99



8823498 $34.99

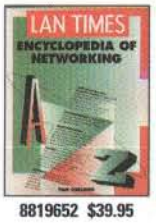
9122736 $34.95

036432X $29.95



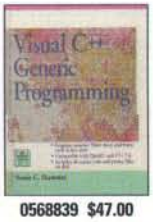
8821991 $27.95

8823870 $34.99

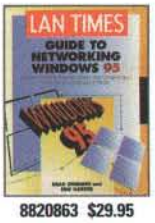


8819652 $39.95

8822092 $34.95



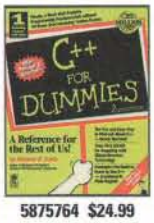
0568839 $47.00



8820863 $29.95

0443661-XX $49.95
Counts as 2

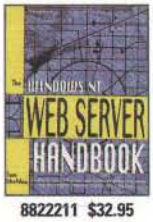
8820448 $16.95



5875764 $24.99

8823129 $29.99

8822807 $24.99

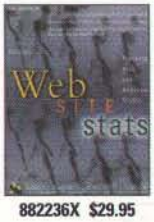


8822211 $32.95

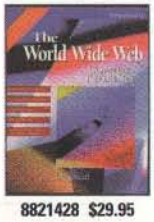
8822661 $29.99

8822319 $39.95

8822629 $39.99

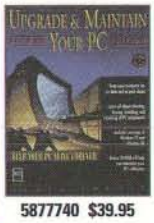


882236X $29.95



8821428 $29.95

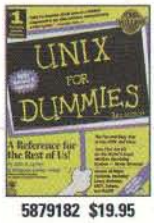
8820901 $27.95



5877740 $39.95

5876353 $24.99

9132286 $49.95



5879182 $19.95

8823919 $39.99

Act now to get these great club benefits:

Substantial Savings... you save up to 50% on every book you buy!

Great Selection... every 3-4 weeks you'll receive the Club Bulletin packed with the latest and best books from all publishers.

Club Convenience... when the Bulletin arrives, if you want the Main Selection do nothing at all — it will be shipped automatically. If you want another book, or no book at all, just indicate your choice on the reply form and return it by the date specified.

Dependable Service... you always have a full 10 days to decide whether you want the Main Selection. If you ever receive a book you don't want due to late delivery of the Bulletin, you can return it at *our* expense.

Generous Bonus Plan... you're automatically enrolled in our Bonus Plan that lets you earn bonus points toward *FREE* purchases.

Easy Membership Terms... your only obligation is to buy two more books within the next 12 months — at regular Club discounts — after which you may enjoy the benefits of membership with no further obligation. You or the Club may cancel membership at any time thereafter.

A shipping/handling charge and sales tax are added to each shipment. All books are paperback unless otherwise noted. Publishers' Prices Shown © 1998 CBC

If card is missing, write to: The Computer Book Club®
A Division of The ***McGraw-Hill*** *Companies*
P.O. Box 549, Blacklick, OH 43004-0549

PHONE: 1-614-759-3666 (8:30 a.m. to 5:00 p.m. EST Monday-Friday)
FAX: 1-614-759-3749 (24 hours a day, 7 days a week)
INTERNET: www.bookclubs.mcgraw-hill.com

BY398

The Best OS for Web Serving: Unix or NT?

Which OS should you be running your Web server on? To find out, we tested NT and five flavors of Unix.
By Barry Nance

Choosing a Web-server platform is a big decision. Unfortunately, the choice isn't as simple as getting the right Web-server product and then buying the hardware and OS that it runs on. Apache, which is the most popular Web server today, runs on all flavors of Unix as well as on Windows NT. Netscape's FastTrack and Enterprise Web servers run on NT and many versions of Unix.

In fact, virtually all Web-server software is multiplatform, with the notable exception of Microsoft's Internet Information Server (IIS), which runs only under NT Server on a Pentium- or Alpha-powered machine.

Of course, if you've already purchased a specific NSAPI-based (Netscape) Web application that runs on a particular version of Unix, your software vendor has already told you which platform to buy. If you have an ISAPI-based (Microsoft) application to run, naturally you'll get NT Server.

However, life isn't always this easy. Perhaps you just want the best platform for publishing Web pages. Or you want the best platform for forms-based CGI processing. If three-tier Web applications are planned for your future, you need the best platform for developing (and running) your cutting-edge software, and one that has available the variety of tools you need.

We pitted NT Server 4.0 against five Unix variants to discover the strengths and weaknesses of each as OSes for hosting Web services. The versions of Unix were four high-end platforms and one low-end alternative: Sun's Solaris 2.6, Hewlett-Packard's HP-UX 11.0, Digital Equipment's Unix 4.0D, IBM's AIX 4.3, and Caldera's OpenLinux 1.1. You should note that in this Lab Report we're focusing solely on the OS alone and its ability to support Web serving, not on the specific hardware or on any particular Web-server software.

For each test, we used 200 clients connected via 100-Mbps 100Base-T Ethernet. Rather than trying to find a common hardware platform, we tested each OS on the kind of hardware it's most likely to be used on—or in some cases, is only available with (see the table "What We Tested On" on page 109).

BYTE BEST
WEB-SERVER PLATFORMS

Digital Unix 4.0D
It has the best I/O engine for pushing out Web pages, plus very good CGI performance. These made it the overall winner, even though it doesn't have as many tools available for developing three-tier applications as do some other Unixes.

We made no attempt to run benchmarks, because a level playing field was not possible with such disparate CPU architectures and computer hardware. Instead, we concentrated our evaluation on OS-specific criteria.

The ideal OS for Web serving will have excellent performance characteristics, easy and intuitive administration, one-OS-fits-all scalability, confidence-building reliability, and trustworthy security. Realizing that people put Web servers to different uses, after we concluded our testing, it became clear that these were all viable systems, but their strengths and weaknesses suited them to somewhat different purposes.

Therefore, we can name three of the OSes as the best in a particular category: three-tier Web-application computing, CGI-based forms processing, and Web-page publishing.

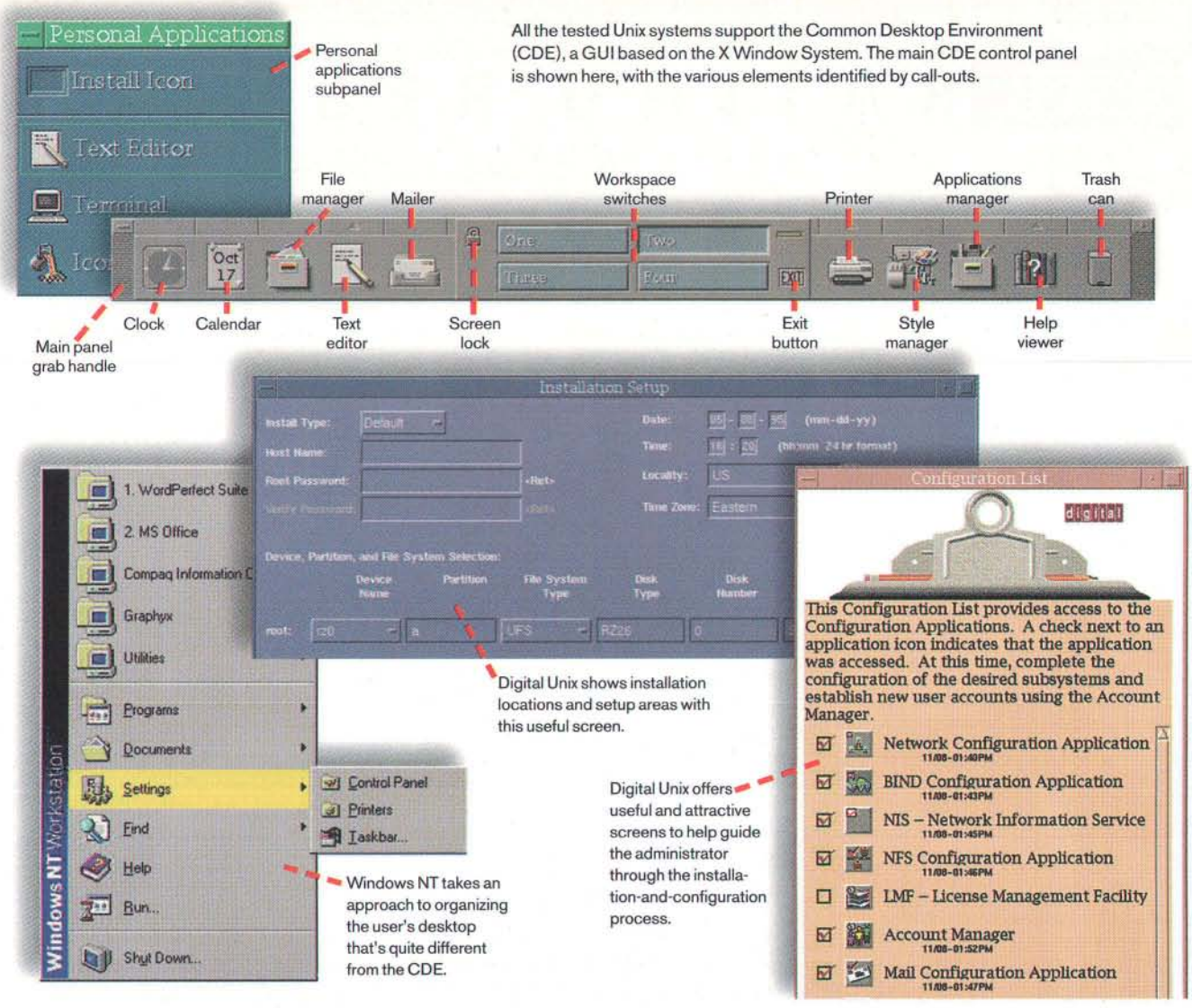
AIX

IBM's AIX provided us with a solid, reliable Web-server platform. Although this was an early innovator in Unix storage management with its Journaled File System (JFS) and system administration utility, SMIT, the competition has now caught up and generally passed it by. AIX is at present a rather unexceptional member of the Unix community.

The most recent version of AIX supports 64-bit applications. However, it's not itself truly 64-bit. Version 4.3 of the OS simply extends the buffers, kernel facilities, and utilities to be 64-bit, and adds 64-bit libraries to the existing 32-bit libraries that it already supplies with the OS.

Regardless of whether users choose to run the OS in either 32- or 64-bit mode, all the device drivers work without modification. IBM offers the 64-bit option despite the company's belief that, because of a lack of applications, 64-bit addressing won't become popular for at least two years.

We found IBM's SMIT, like HP's SAM, to be a decidedly nonstandard administration tool. Instead, we preferred to



While OSes generally don't lend themselves to interesting screens, we found the Unix world's CDE desktop a pleasant alternative to the familiar NT screen.

use the AIX Web-based system management tools, which let us configure AIX from anywhere on the network. But the Web-based tools need a Java 1.1–enabled browser. Also, the administration tool's Welcome Center uses a graphical "RS/6000 from Mars" theme to grab your attention, but we found those screens annoying and garish.

AIX supports Java quite well, and IBM bundles a Java Development Kit (JDK), a just-in-time (JIT) compiler, and several other Java tools with AIX.

Digital Unix

Digital Unix showed itself to be the best platform for publishing static Web content. This OS is, in essence, a turbocharged I/O engine. In our tests, it served up static Web pages nearly instantaneously. To discover why this was the case, we monitored the OS in detail as it processed requests from the Web server and found that Digital Unix's disk I/O drivers and TCP/IP stack drivers are blazingly fast. As a matter of fact, they're likely the best-written drivers in the industry.

In addition, because Digital Unix is a true 64-bit OS, it can (given sufficient RAM) cache ultralarge Web sites in memory and serve up Web pages without needing any disk I/O whatsoever. Symmetric multiprocessing (SMP) support is similarly optimized, and Digital Unix is efficient enough to act as a real-time OS (RTOS), a challenge that the other versions of Unix and NT wouldn't attempt.

System management, via Digital's SysMan user-friendly graphical interface, was quick and painless. We used Logical Storage Manager's drag-and-drop visual environment to easily configure Unix file systems. We put Internet AlphaServer System Software (IASS) to work whenever we needed to manage users, groups, and various system components, including security, Web servers, anonymous FTP, squid proxy/caching server, Internet news (INN), and mail.

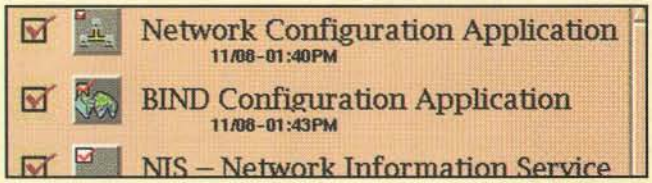
However, some of the Internet components that Digital provides with IASS cannot be configured using the IASS Administration utility. Thus, we had to resort to command-line utilities to enable and disable the Basic Merit AAA Radius authentication server, IMAP servers, Internet Relay Chat (IRC) server, LDAP server,

LAB RATING RESULTS

BEST OVERALL

Digital Unix 4.0D

With its combination of blazing I/O and excellent CGI support, Digital's 64-bit OS was the clear winner as the best OS platform on which to host a Web server.



	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	OVERALL RATING
Digital Unix 4.0D	★★★★	★★★	★★★★★	★★★	★★★★
Microsoft Windows NT 4.0	★★★★★	★★★	★★	★★★★	★★★★
Sun Solaris 2.6	★★★	★★★	★★★	★★★	★★★
Hewlett-Packard HP-UX 11.0	★★★	★★★★	★★★★	★★★	★★★★
IBM AIX 4.3	★★	★★★	★★★	★★	★★
Caldera OpenLinux 1.1	★	★★	★	★★	★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

POP-3 server, and the poppassd password-changing server.

HP-UX

HP-UX is nearly as good an I/O engine as Digital Unix, but it doesn't have the wealth of three-tier Web-application niceties that NT offers, and it's somewhat nonstandard (from a traditional Unix perspective) to administer. However, HP-UX is without a doubt the most secure Web-server OS of all those we tested for this report.

Virtually all versions of Unix now supply C2-level security. NT also offers C2 plus "Red Book" network extensions to those sites needing extra security. HP-UX takes security to the higher B1 level. To achieve this degree of protection, it uses a separate code base and disables some common features, such as the system administration module, SAM. With HP's Praesidium enterprise security framework, a Web site can be accessible to the public Internet without fear of malicious or even inadvertent damage.

HP Praesidium components include Authorization Server, Security Service, and Cryptographic Module. Security Service features authentication services for the Praesidium Authorization Server and provides a basic access-control list (ACL) that controls who can access specific applications and resources. Security Service also has a registry service for managing the security database, an audit service to track and record the use of security services, and data-encryption software to protect transmitted data.

HP-UX is also noteworthy for its reliability and recent embracing of the 64-bit Unix standard (in contrast, Digital Unix has been 64-bit for years). HP-UX integrates tightly with the PA-RISC computer hardware to gracefully avoid faulty processors, memory, and disk drives. In an SMP environment, it can take a faulty processor offline without rebooting and can similarly deallocate faulty memory.

HP claims that future descendants of HP-UX 11.0 will run on both HP's 64-bit PA-RISC 8x00 as well as the Intel Merced processor, which is based on an architecture jointly developed by HP and Intel.

OpenLinux

We liked Caldera's OpenLinux for its simplicity and robustness. Unfortunately, we cannot equate that robustness with the sort of reliability that the other products gave us. We never encountered an OS bug while testing OpenLinux, but it did terminate rather ungracefully when it was confronted with nontrivial processor, memory, and disk drive hardware failures. This OS provided us with more thrills than frills, reminding us of the "fun" we used to have with the plain, uncomplicated Unix implementations of years past.

OpenLinux is Caldera's value-added distribution of the shareware Linux. To the basic Linux kernel product, OpenLinux Standard 1.1 adds the X Window

Purchasing a Platform

Have you sometimes wondered why a large company would use its size as a club to buy desktop units at unbelievably low prices and then do an apparent about-face to spend hundreds of thousands of dollars on a midrange computer without negotiating just as hard? The inconsistency disappears when you stop to consider who's doing the purchasing and how much of a return the company expects on its computing investment.

Because they are now commodity items, desktop units typically come from a budget that's not all that different from the budgets for staplers, desk furniture, and telephones. A newly hired employee in the accounting department gets a desk, a PC, a stapler, and a telephone.

On the other hand, the head of the business organization who spends $100,000 or more on the midrange computer expects a 10-, 20-, or even 100-fold payback on his or her investment (with, naturally, the responsibility and accountability for actually realizing that payback). He or she negotiates with the computer vendor, but the chief concerns are issues such as uptime (will the vendor guarantee 99.5 percent?), training, administration, maintenance (will the company need to hire a person to care for the new system, as well as cross-train others?), and the useful life of the new computer (will the business community be able to sustain the rate of return from the investment over a long period of time?).

Because of the magnitude of the expected payback, the initial cost of the computer system is usually not the biggest concern to information technology (IT) management. The recurring costs (primarily in terms of people, downtime, and risk of erosion of the system's ability to satisfy future needs) are the most important factors affecting the purchase decision.

WEB SERVERS FEATURES

	Hewlett-Packard HP-UX 11.0	Digital Unix 4.0D ★B	IBM AIX 4.3	Microsoft NT Server 4.0	Sun Solaris 2.6	Caldera OpenLinux 1.1
Price	N/A	N/A	N/A	$809	$695	$399
PROCESSOR ENVIRONMENT						
Processor	PA-RISC	Alpha	PowerPC	Intel, Alpha	SPARC, Intel	Intel
Support 32-bit apps	✔		✔	✔	✔	✔
Support 64-bit apps, file system	✔	✔	Partially			
Maximum CPUs	16	12	8	4	64	1
Maximum RAM	16 GB	28 GB	3.75 GB	4 GB	30 GB	4 GB
Maximum addressable memory	18 EB	18 EB	4 GB	4 GB	4 GB	4 GB
Maximum shared memory	8 TB	4 GB	4 GB	4 GB	4 GB	4 GB
APPLICATION ENVIRONMENT						
Largest file system size	1 TB	512 TB	2 TB	18 EB	2 TB	N/A
Maximum file size	1 TB	17 TB	64 GB	18 EB	1 TB	N/A
NFS v3	✔	✔	✔	Optional	✔	
Posix-compliant kernel threads	✔	✔	✔	✔	✔	
Common Desktop Environment	✔	✔	✔		✔	✔

★B = BYTE Best ✔=yes; N/A=not applicable; EB=exabytes

System, developer tools, Apache Web Server, JDK, Netscape Gold, Netscape FastTrack Server 2.0, and HTML editing tools. Netscape FastTrack Server 2.0 is an entry-level Web server that is great for publishing static Web pages but less than useful for serious Dynamic HTML (DHTML) pages or three-tier Web applications. Late in 1997, however, Caldera announced plans to port Netscape's industrial-strength Web-server software, SuiteSpot 3.0, to OpenLinux. This should be a significant addition.

Unfortunately, installation and administration of OpenLinux is almost wholly manual compared to the other versions of Unix. For instance, OpenLinux required us to manually create the swap and primary Linux partitions, and, in contrast to the other versions of Unix, we also had to manually fine-tune our monitor, video card, and mouse settings before we could start the X server.

Sun Solaris

For running CGI-based Web applications (those with FORMS statements embedded in HTML), we found Solaris the best of the lot. Further investigation showed that its task and process management functions were notably quicker and more efficient than those of the other platforms, and CGI places a heavy burden on an OS's ability to launch programs. Solaris, not surprisingly, also has superior support for Java. We applaud Sun for offering Solaris for Intel machines as well as on its own SparcStations, a strategy that helps Solaris scale downward onto inexpensive desktop machines and that may be significant for many users.

Solaris was easy to configure in our tests, and the ability to remotely perform almost all administrative tasks was the icing on the cake. We used both command-line utilities and Sun's Web Start browser interface to manage system resources, including partition sizes, available sockets, maximum threads per user, and other parameters. The Java-based configuration utilities were generally intuitive in use, and, because of the effectiveness of Sun's JIT compiler, we found them to be highly responsive.

In our testing, we found that this newest version of Solaris is faster than its predecessors. Sun has improved the disk I/O code path as well as the TCP/IP stack drivers. Nonetheless, Solaris lagged behind both Digital Unix and HP-UX in sheer throughput.

Security is another area in which Solaris needs improvement. Version 2.6 has added the ability to use Plug-In Authentication Modules (PAMs) as well as Generic Security Services API (GSSAPI), and the OS offers virtual private network (VPN) security. However, Solaris 2.6 still lacks transport-layer security, and it cannot restrict access for specified hours of operation.

Microsoft Windows NT Server

So how well does Redmond's OS compare to this group of Unix products? Considering its usefulness as a Web-site host, we particularly liked NT's integration of Active Server Page (ASP) Web scripting, Web-server software (IIS), transaction processing (TP) monitoring (Transaction Server), message-oriented middleware (MOM, implemented as Microsoft Message Queuing, or MSMQ), and Microsoft Management Console (MMC).

These built-in features, along with NT Server's internal functions and graphical interface, make NT Server the only one of these six platforms for which designing a three-tier application would be easy and fun. Additionally, NT has the widest range of third-party development tools, including a remote Web management interface as well as a BASIC-like language for scripting configuration changes. NT also let us

What We Tested On

OS	Computer hardware	Number of CPUs	RAM
AIX	IBM R50 RS/6000	2	512 MB
Digital Unix	400-MHz Digital AlphaServer	2	512 MB
HP-UX	HP 9000 K460	1	1 GB
OpenLinux	300-MHz Pentium II	1	128 MB
Solaris	Sun Netra i20	2	128 MB
Windows NT Server	300-MHz Pentium II	1	128 MB

crash-protect Web applications by putting them in separate address spaces.

Unfortunately, NT still seems unable to gracefully survive machine checks, disk space exhaustion, and its own very rare OS bugs. Therefore, you'll need to keep a watchful eye on its day-to-day operation. (BYTE's Webmaster, Jon Udell, has commented that, in the village of servers that service the BYTE site, the NT servers occasionally go down... but the Unix machines have never failed.)

Clustering NT machines isn't yet a viable solution, because NT's clustering technology hasn't yet reached a level of reliability we'd call adequate. (With the exception of OpenLinux, all the Unix vendors offer robust clustering.) And too many kinds of NT configuration changes require rebooting the OS, which can be both annoying and disruptive. We find NT eminently suitable for running three-tier applications, as long as they don't require 24-hour, seven-day uptime.

In our tests, we found that NT ran slowest when configured to use its own NT File System (NTFS). NT's Web-page serving sped up considerably when we switched to NT's software-based disk striping. NT 4.0, updated by Microsoft's Option Pack, shows significant performance gains over earlier versions of NT, especially in its support of 100Base-T networking. However, the combination of NT and even a fast Pentium processor produced Web pages at a much slower rate than any of the other platforms we tested. Fortunately, Pentium-based machines are inexpensive commodity items.

At Your Service

No OS is a perfect platform on which to run a Web server, but because the basic function of most servers is to push out Web pages, we're picking Digital Unix as the best overall choice, despite its lack of available three-tier development tools. For those kinds of applications, our testing shows that NT is currently the best OS. For CGI-based processing, Solaris easily outshone the others. HP-UX deserves special mention for its high level of security, and it was very nearly as good as Digital Unix at serving up static Web pages.

Perhaps NT will someday offer the reliability of AIX or HP-UX. Or perhaps Solaris and OpenLinux will become 64-bit powerhouses for serving up ultralarge Web sites to a myriad of clients. Until then, however, you'll have to make compromises when you choose an OS for your Web sites. B

Barry Nance, a BYTE consulting editor and a computer analyst and consultant for 25 years, is the author of Introduction to Networking, *4th ed. (Que, 1997),* Using OS/2 Warp *(Que, 1994), and* Client/Server LAN Programming *(Que, 1994). You can reach him via the Internet at* **barryn@bix.com.**

TECH FOCUS PERFORMANCE

Tuning Your Unix

If your Web site uses Unix-based servers, at some point you'll want to tweak the OS to improve performance. A good place to start is with the vmstat, iostat, netstat, and sar Unix utilities. These tools display statistics that can help you decide what you need to do.

The vmstat command shows utilization of system resources—memory, disks, interrupts, system calls, context switches, and CPU. It also shows paging activity and information on kernel threads in the run and wait queues. This command breaks down CPU activity by categories that include user mode, system mode, idle time, and waiting for disk I/O. You can use vmstat to find out whether a system is CPU-bound, memory-bound, or I/O-bound.

If you suspect a Unix machine is I/O-bound, the iostat utility can help you locate the problem. The tool reports CPU statistics and I/O statistics for TTY devices, disks, and CD-ROM drives. It monitors system I/O device use by relating the time each physical disk is active to its average transfer rate. The iostat utility can reveal, for example, whether a physical volume has become a performance bottleneck. You can use the tool's statistics to better balance the I/O work load among the system's physical disks.

The netstat utility shows network status and indicates the reliability of the local network interface. Classically, administrators use netstat more for problem determination than performance measurement. However, you can use its statistics to determine the volume of network traffic and thus get an indication of whether network congestion is causing performance problems.

For each network interface, netstat tells you the address of the protocol control blocks associated with the interface's sockets as well as the status of the sockets; the number of packets received, transmitted, and dropped; network routes and their status; and cumulative counts of error-collision packets.

Finally, sar is a popular Unix administrator's tool for gathering performance statistics. Be aware, however, that sar is somewhat intrusive and can skew the performance data by a small amount as it increases system work load. The utility offers a wide variety of command-line options that let you specify the kinds of system activities you're interested in monitoring. It can divulge, for instance, useful information about queuing, paging, and TTY events. For symmetric multiprocessing (SMP) systems, sar can typically also show CPU use globally, for all processors or individually by processor.

These tools can help you tune a Unix-based Web site to run smoothly and efficiently. Yes, they're a little like rocket science. So read the technical references and go launch a rocket.

PRODUCT INFORMATION

AIX 4.3
(available with RS/6000 systems)
IBM
http://www.rs6000.ibm.com/software

Digital Unix 4.0D
(available with Digital servers)
Digital Equipment Corp.
Maynard, MA
http://www.Unix.digital.com
Enter HotBYTEs No. 1055.

HP-UX 11.0
(available with selected PA-RISC systems)
Hewlett-Packard Co.
Palo Alto, CA
415-857-1501
http:// www.hp.com/computing
Enter HotBYTEs No. 1056.

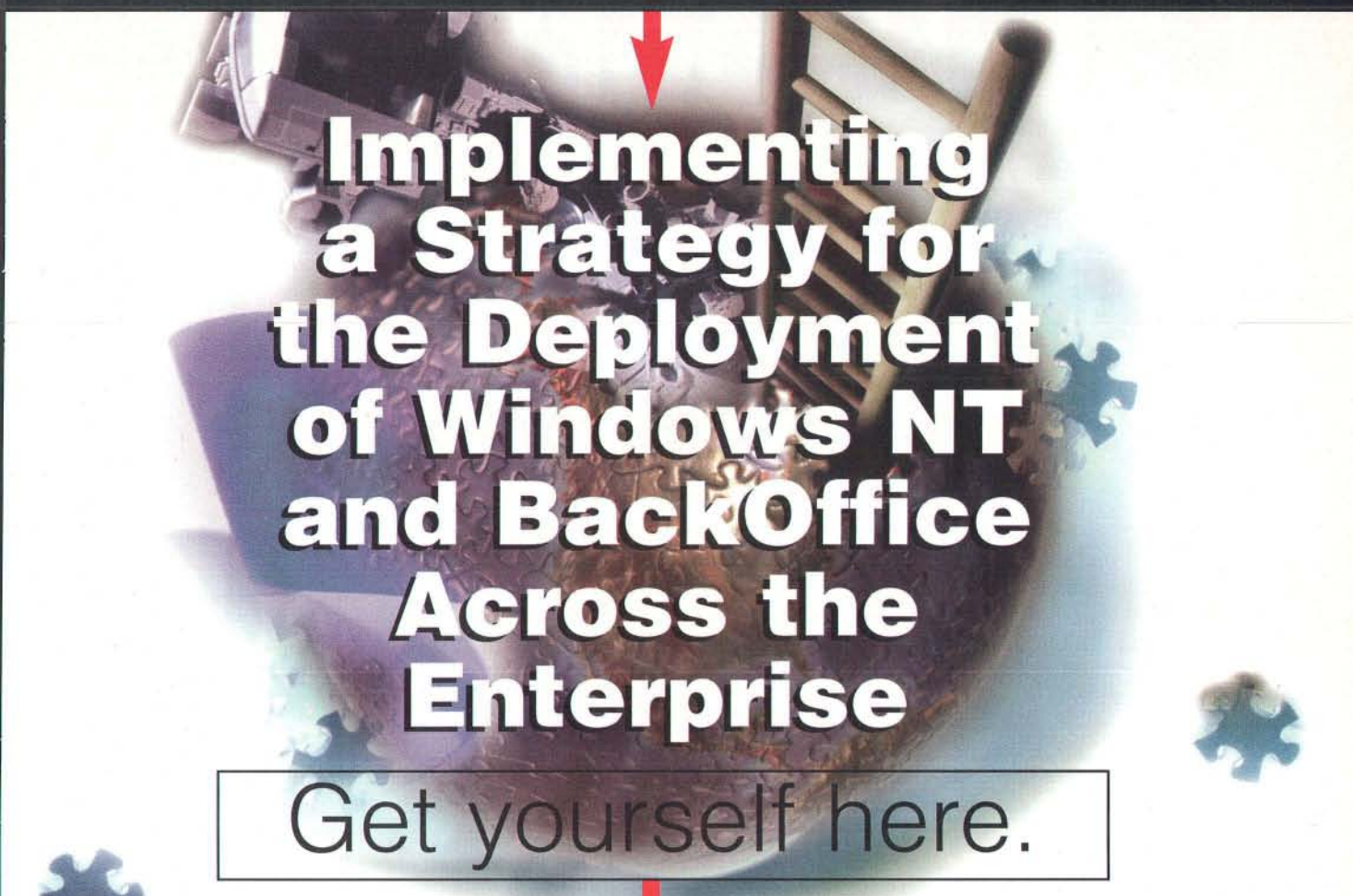
OpenLinux 1.1
Caldera
Provo, UT
800-850-7779
801-377-7687
fax: 801-377-8752
http:// www.caldera.com
Enter HotBYTEs No. 1057.

Solaris Server 2.6
(available for SPARC- and Intel-based servers)
Sun Microsystems
Palo Alto, CA
800-786-7638
415-960-1300
http://www.sun.com/solaris
Enter HotBYTEs No. 1058.

Windows NT Server 4.0
(available for Alpha- and Intel-based servers)
Microsoft
Redmond, WA
425-882-8080
fax: 425-936-7329
http:// www.microsoft.com/ntserver
Enter HotBYTEs No. 1059.

at http:/www.byte.com/hotbytes/

If you're here ...



Implementing a Strategy for the Deployment of Windows NT and BackOffice Across the Enterprise

Get yourself here.

Advanced I.T. SOLUTIONS '98

Deployment of Windows NT and BackOffice Across the Enterprise

Pennsylvania Convention Center
Philadelphia, PA — April 6 - 9

Are you left confused about what's ahead in Windows NT and BackOffice technology? Then mark your calendar and plan to attend Advanced I.T. Solutions '98. This is your chance to get the answers you're looking for from professionals who've already designed and implemented enterprise I.T. solutions. Learn how to achieve success at every level of the organization — from the desktop to enterprise-wide — using Windows NT and BackOffice Technology. Attending this technical conference will provide you the information and insight to know ...

How do I successfully scale Windows NT 3.51 and 4.0 across my enterprise today?

How to develop and execute the required strategies that will provide your enterprise the least painful transition path to Windows NT 5.0. This will include how best to deploy Windows NT 3.51 and 4.0 today in order to get ready for Windows NT 5.0 tomorrow.

Plus so much more ...

Visit over 150 system integrators, software application providers, and platform vendors!

For more information, visit our Web site at www.advanceditsolutions.com or call, toll-free, 1-800-332-8755 or 1-978-506-3410. For information on how to exhibit at the show, call John Greco toll-free at 1-800-974-2270.

Visit www.advanceditsolutions.com

Produced by: PennWell DECUS | Supported by: BackOffice Magazine | Industry Sponsors: digital Microsoft | Media Sponsors: CIO BackOffice Magazine ent Government Computer News BYTE NT Manufacturing Philadelphia Business Journal Managing Automation

3-D is ready—even if you aren't. Don't get left behind with a graphics engine that won't deliver.
By Rob Hummel

Render Benders: 26 Graphics Cards for Fast 3-D

Make no mistake: This is the year you will move to a 3-D video board—if you're not already there. The benefits are so compelling and the cost is so small that you'll be hard pressed to justify resisting the upgrade.

Support for OpenGL graphics, the sole province of $100,000 workstations just a few years ago, has moved so rapidly down the food chain that it's now built into every copy of Windows. To this mix, add emerging 3-D applications that go beyond games to enable the business use of rendering and visualization. Finally, factor in Intel's aggressive marketing of its new Accelerated Graphics Port (AGP) graphics bus and Microsoft's push for its Direct3D interface, and the conclusion is inescapable.

3DLabs: Market Leader

Faster, better, cheaper—the three horsemen of technological advancement—have ridden hard over the past year in an effort to move 3-D video forward to the same level as processor, memory, and mass-storage subsystems. The result has been superbly affordable 3-D chip sets tailored to varying levels of performance.

The boards that we selected for this round-up fall neatly into three different groups based on their core chip sets. Four of the five high-end boards are built around the Glint MX chip. The Glint MX, 3DLabs' third-generation graphics processor, combines workstation-class 3-D graphics with 2-D Windows acceleration. All four of these video boards paired the MX processor with the Glint Delta chip, a geometry processor that speeds OpenGL graphics performance by off-loading calculations from the host CPU. The sole independent in the high-end category was Intergraph, which uses a proprietary graphics processor.

Every one of the dozen mid-range boards we tested was based on the Permedia 2 chip set, also from 3DLabs. A second-generation low-cost processor targeted at the consumer market, the Permedia 2 integrates SVGA, 2-D and 3-D acceleration, and MPEG-2 video acceleration in a single device. The chip's architecture can accommodate from 2 to 8 MB of video memory (all the boards we tested were equipped with 8 MB) and a 16-bit z-buffer.

3DLabs also provides a set of reference drivers for OpenGL and Direct 3D under Windows NT and 95, making it easy for manufacturers to offer a low-cost 3-D video solution for both platforms. As popular as 3DLabs' chips are, they're clearly not for everyone. A third group of boards we tested used a variety of chips, developed either by the board's manufacturer or by other independent chip makers.

The nine independents we tested included three boards based on ATI's 3D Rage Pro, three using nVidia's Riva 128, and one each using Number Nine's "Ticket to Ride," 3Dfx's Voodoo Rush, and Matrox's MGA-2164W. The design goal for these chips must have been something other than speed, as they all turned in significantly lower 3-D performance scores than the Permedia 2–based boards.

Versatility

Some 3-D graphics board manufacturers define extremely narrow goals for their boards—to the exclusion of all else. High-end boards, for example, often emphasize speed when rendering 3-D images using OpenGL under NT. Applications that don't fit this narrow definition are simply unsupported, even to the extent that no driver support for running Windows 95 is provided. That's fine if your requirements are equally as narrow. But if, as a developer, you plan to dual-boot your system to test your new application under both OSes, for example, you'd best choose a different board.

Other boards take the opposite tack, trying to be all things to all users. In

BYTE BEST
3-D GRAPHICS CARDS

Leadtek Research
WinFast 3D L2300
The WinFast 3D L2300 gets double honors for Best Overall and Best Value. At $169, it bested every other board in the 8-MB-and-less category, turning in top scores in both 3-D Viewperf tests. An outstanding value, it provides the most cost-effective performance of any board in this roundup.

Intergraph Computer Systems
Intense 3D Pro 2200S
This is the unabashed performance leader in the high-end category–and, at $2387, the most expensive board we tested. The Intense 3D Pro 2200S squeaked past its four companions, aided primarily by its extraordinary score on the Viewperf CDRS benchmark.

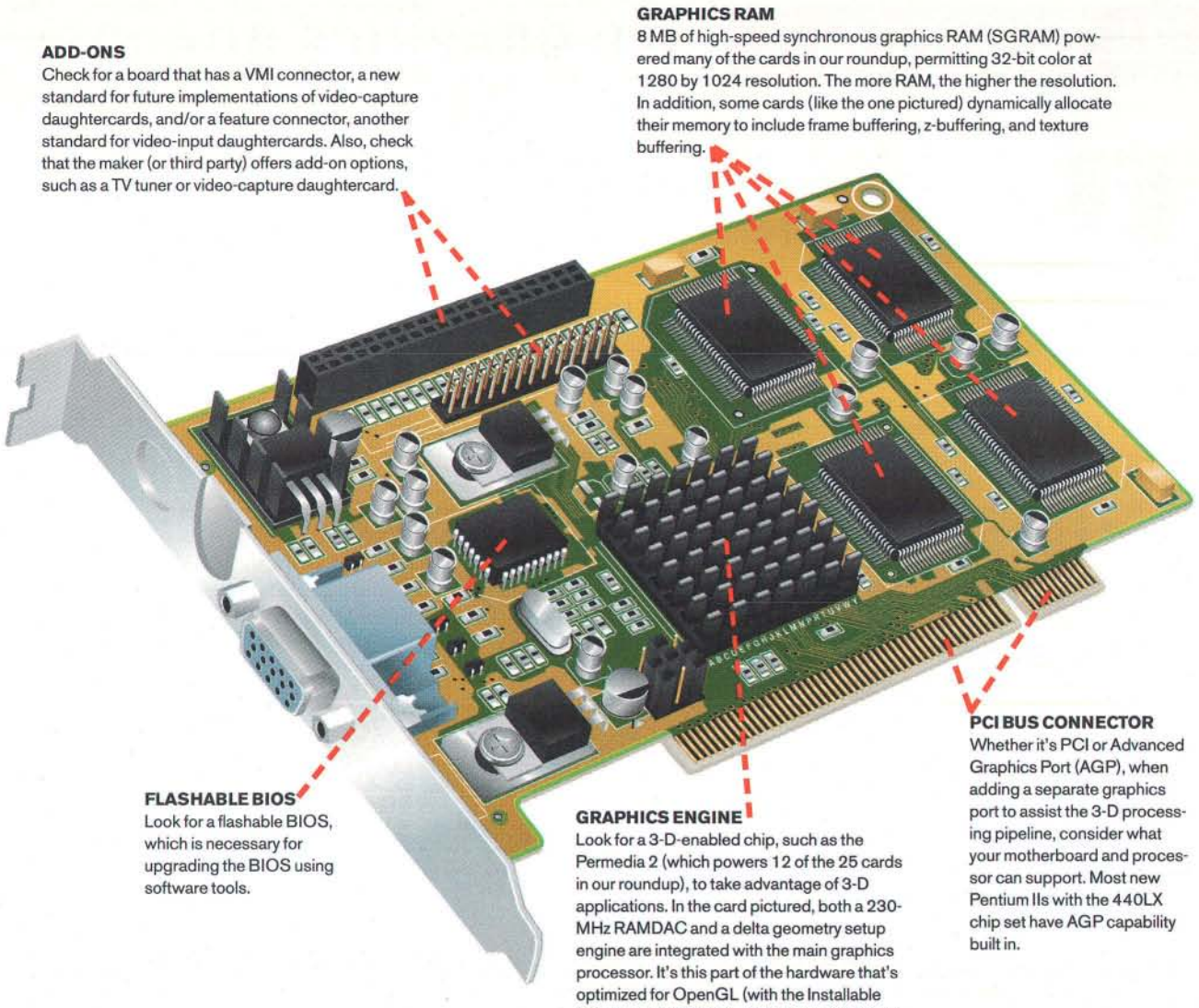


Illustration is based on the Leadtek WinFast 3D L2300.

most cases, they trade off versatility for either performance, price, or both. If you really want video in, video out, MPEG acceleration, and a TV tuner to boot, you've got to be prepared to pay for these features in one way or another.

Defining the Field

When we asked the manufacturers of these 3-D graphics accelerators to provide hardware for this Lab Report, we gave them enough flexibility to squeeze in a variety of video offerings. As a minimum, each board had to support 1024 by 768 pixels with 24- or 32-bit color and 1280 by 1024 pixels with 16-bit color. A z-buffer of at least 16 bits and a refresh rate of at least 75 Hz were required at the 1024 by 768 resolution. The boards also had to support digital video acceleration for MPEG. If a manufacturer provided a board in both PCI and AGP configurations, it could submit one or both versions.

Most video board manufacturers responded with enthusiasm. In the low-end and midrange categories, 12 vendors submitted a total of 21 boards—13 based on PCI and eight based on AGP. All the midrange boards had 8 MB of video memory, while the low-end boards ranged from 4 to 8 MB.

Just as performance did not correlate directly with the amount of graphics RAM on a card, prices for the boards did not equate with performance or features. You can get the least costly board we tested in these two categories for under $170, while the most costly one is about $300.

Five vendors provided entries for the high-end category. These boards provided from 16 to 48 MB of video memory, supported 24- and 32-bit z-buffers, and ranged in price from $1200 to $2400.

Several boards we received from manufacturers could not be tested due to technical problems. A beta unit of Hercules' Thriller 3-D wouldn't run the Viewperf tests. We got two Righteous 3D boards from Micronics/Orchid but were unable to get them to work in our test system. We were also unable to get a Videologic Apocalypse 5D board to run under NT. A replacement board arrived too late to test.

Contributors
Steve Platt, Managing Editor/NSTL
Dorothy Hudson, Project Manager/NSTL
Michelle Campanale, Technical Editor/BYTE
Linda Higgins, Editorial Associate/BYTE

ILLUSTRATION: SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1998

BEST OVERALL 3-D GRAPHICS BOARDS

3-D technology and the applications that use it are changing so rapidly that price, performance, and features won't stand still long enough to make for meaningful comparisons. That's the problem we faced when choosing our winners.

If you're looking for a 3-D graphics accelerator, it's safe to assume that your primary objective is performance. Therefore, we gave performance scores a hefty 50 percent weighting when determining our Best Overall winner.

Important as it is, performance isn't the whole picture. To differentiate their boards, vendors try to add value in the form of built-in or bundled features. Consequently, we allocated 20 percent of the Best Overall score to features.

Performance Leader

The unabashed performance leader of this group was the Intergraph Intense 3D Pro 2200S. Turning in the top score in the CDRS OpenGL viewset, which emphasizes texturing and modeling, the Pro 2200S's proprietary graphics engine beat its nearest competitors by more than 25 percent. Not coincidentally, the $2400 Intergraph is the most costly of the boards that we tested. Its performance wasn't as good on the OpenGL DX viewset, however, where 16 boards—some costing as little as $179—beat the Pro 2200.

But the composite performance scores (a combination of CDRS, DX, and Bapco) of the five top-tier boards varied only a few percent either way. Their overall scores were nearly identical as well. All other things being equal, this makes the $999 Symmetric GLyder MX GMX3A PCI board stand out as a bargain in the high-end group. Populated with 16 MB of video memory, this Glint MX–based board is a great value among the high-end 3-D graphics cards we tested.

First Among Peers

An old saw says that if you stand with one foot on a block of ice and the other in a fire, on average, you'll be miserable. That neatly sums up the pitfall in using a single average score for determining an overall winner. Nonetheless, despite wide and varied criteria, we picked the Leadtek Research WinFast 3D L2300 AGP board as the overall winner.

The L2300 turned in the best performance score of any board with 8 MB or less video memory, distinguishing it even among its Permedia 2–based cousins. Leadtek attributes much of this performance to aggressive reengineering of the stock 3DLabs board design. With an aggregate performance score only 6 percent behind that of the 40-MB Glint MX–based Elsa GLoria-XL, the L2300 is a potent solution for moderate graphics required by entry-level workstations.

Close behind the L2300 in overall score were the other members of the Permedia 2 pack. Buoyed by a high features score, the Creative Labs Graphics Blaster Exxtreme lagged behind by about 5 percent. The Hercules Dynamite 3D/GL and

TECH FOCUS CDRS COMPOSITE

A Better Measure of Value

In March 1996, a Hewlett-Packard J210XC/Freedom Series 3400 computer system with 64 MB of RAM and a 2-GB hard disk sold for $115,660 and posted a CDRS composite of 50.78—a cost of $2278 per composite. Today the situation is remarkably different. The top-rated system is a Hewlett-Packard 9000/782/C240 with a Visualize-Fx6 with texture option. For just $56,615, you get 512 MB of RAM, a 9-GB hard disk, and a CDRS composite of 200.00—a lot more performance, and at a cost of only $283 per composite. (For competitive comparisons, OpenGL performance is characterized in terms of dollar cost per CDRS composite.)

High Value, Low Cost

To make the performance ratings of the video boards in this roundup more meaningful, we've calculated the cost per CDRS composite of each of the boards installed in a system we consider an entry-level 3-D workstation: a $3000 300-MHz Pentium II with 128 MB of RAM, a 6-GB hard disk, and a 19-inch monitor (the same specifications as our test PC). We added in the cost of each video board and divided the total system cost by the board's CDRS composite score. The results are shown in the graph at right.

The WinFast 3D L2300 AGP card, for example, costs $169 and produces a system with a $119-per-composite cost. The Intense 3D Pro 2200S PCI board costs $2387—nearly 13 times the cost of the L2300. But its $136-per-composite cost is a more reasonable—and meaningful—increase of only 14 percent.

The impact of the more costly video boards is greatly moderated by the cost of the computer system. The more expensive the nonvideo components are, the more cost-effective it becomes to invest your money in a better-performing video board.

Cost per CDRS Composite

High-end graphics workstations used to come as turnkey systems from a few specialty vendors. Today, it's more common to assemble entry-level or midrange systems from pieces, tailoring each subsystem to meet specific requirements.

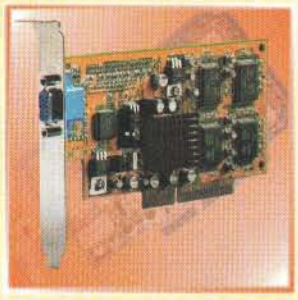
But this practice tends to overemphasize the cost of individual components rather than their contribution to total system cost. Selecting a $2000 video board over a $200 one is easier when the target is a $50,000 workstation. So, although performance is important, the information has more meaning when the cost of that performance is expressed in terms of the entire system.

LAB RATING RESULTS

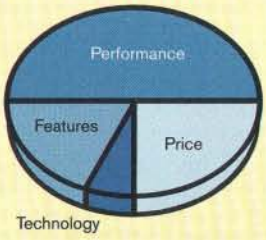
BEST OVERALL/BEST VALUE

Leadtek Research WinFast 3D L2300

Double honors for Best Overall and Best Value go to the Leadtek Research WinFast 3D L2300. The 8-MB WinFast 3D L2300 outperformed every other board in its class and came within a whisker of high-end boards costing over 10 times as much. At $169, it provides the most performance per dollar of any board in the roundup.



WEIGHTING

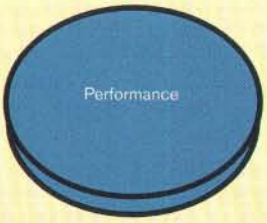


BEST PERFORMANCE

Intergraph Computer Systems Intense 3D Pro 2200S

In terms of aggregate performance, the Pro 2200S can't be beat. With the highest CDRS score, the Pro 2200S edged out every other card in this roundup. But unless money is no object, its $2387 price tag and high cost/performance ratio may have you looking elsewhere.

WEIGHTING



	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Leadtek Research WinFast 3D L2300 (AGP)	**$169**	★★★★	★★★★	★★★★	★★★★	★★★	★★★★★
Creative Labs Graphics Blaster Exxtreme (PCI)	$200	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★
Diamond Multimedia Systems Viper V330 (PCI)	$180	★★★	★★★	★★	★★★★	★★★★	★★★★
Diamond Multimedia Systems Fire GL 1000 Pro (AGP)	$225	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★★
Hercules Dynamite 3D/GL 6218GL (PCI)	$249	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★
Hercules Dynamite 3D/GL 7218GLA (AGP)	$249	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★
Symmetric GLyder Max-2 (AGP)	$229	★★★★	★★★★	★★★★	★★★★	★★	★★★★★
Symmetric GLyder Max-2 (PCI)	$229	★★★★	★★★★	★★★★	★★★★	★★	★★★★★
AccelGraphics AccelStar II (AGP)	$279	★★★★	★★★★	★★★★	★★★	★★★★	★★★★
AccelGraphics AccelStar II (PCI)	$279	★★★★	★★★★	★★★★	★★★	★★★★	★★★★
Elsa GLoria Synergy (PCI)	$299	★★★★	★★★★	★★★★	★★★	★★★★★	★★★★
Elsa GLoria Synergy (AGP)	$299	★★★★	★★★★	★★★★	★★★	★★★★★	★★★★
Omnicomp Graphics 3Demon MX 16/16 (PCI)	$1700	★★★★★	★★★★	★★★★	★★★★	★★★	★★★★
Leadtek Research WinFast 3D L2520 (PCI)	$1199	★★★★★	★★★★	★★★★	★★★★	★★★	★★★★
Symmetric GLyder MX (PCI)	$999	★★★★★	★★★★	★★★★	★★★★	★★	★★★★
Elsa GLoria-XL (PCI)	$1799	★★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★
ATI Technologies XPert@Work (PCI)	$169	★★★	★★★★	★★	★★★★	★★★★★	★★★★
Intergraph Intense 3D Pro 2200S (PCI)	$2387	★★★★★	★★★★	★★★★★	★★★	★★★	★★★★
Diamond Multimedia Systems Fire GL 1000 Pro (PCI)	$225	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★★
ATI Technologies XPert@Play (PCI)	$219	★★★	★★★★	★★	★★★★	★★★★★	★★★★
STB Systems Velocity 128 (PCI)	$199	★★★	★★★★	★★	★★★★	★★★★	★★★★
STB Systems Velocity 128 (AGP)	$199	★★★	★★★★	★★	★★★★	★★★★	★★★★
Jazz Multimedia Adrenaline Rush 3D (PCI)	$199	★★★	★★★★	★	★★★★★	★★★★★	★★★★
Matrox Graphics Millennium II (PCI)	$269	★★★	★★★★	★★	★★★★★	★★★★★	★★★★
ATI Technologies All-In-Wonderpro (AGP)	$279	★★★	★★★	★★	★★★★	★★★★★	★★★
Number Nine Revolution 3D (PCI)	$299	★★★	★★★	★★	★★★★	★★★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

PHOTOGRAPHS: STEVEN GREENBERG © 1998

Diamond Fire GL 1000 Pro boards trailed by 7 percent and 8 percent, respectively. The Symmetric GLyder Max-2 and AccelGraphics AccelStar II boards were down by 10 percent and 13 percent, compared to the Leadtek L2300.

Given the relatively close overall and performance scores, choosing one of these boards over the others could be difficult. None offers video in or video out, and most implement some variation of the chip-enabled VMI interface bus. Only the Diamond Fire GL 1000 Pro breaks from the rest of the pack to offer a StereoGraphics port for 3-D glasses.

Value Leader

With little in the way of features, performance, or technology to distinguish the Permedia 2 boards, it should come as no surprise that price played a major role in establishing our value ratings. With a street price of $169, Leadtek's WinFast 3D L2300 AGP board was a shoo-in as the best value winner.

In terms of performance per dollar for entry-level and midrange 3-D graphics systems, the WinFast 3D L2300 handily beat every other board. Higher prices and lower performance eliminated the other boards in the 8-MB-and-less group. And those higher prices, coupled with little proportional gain on the Viewperf tests, make the high-end boards seem less attractive.

For our tests, we defined *value* as the cost of performance while running the Viewperf and Bapco tests. You'll have to toss your requirements into the mix to get the best board for your application.

Clearly, much of the confusion concerning 3-D solutions can be traced to the difficulty in defining the 3-D user. As recently as a year ago, there were two distinct 3-D markets. At the high end was professional-quality, real-time, 3-D image generation and rendering. Built around costly graphics boards and multi-CPU designs, these cards delivered performance at a price premium.

At the low end of the spectrum were the gamers. Because games demanded faster and more realistic imaging, texture-mapping, and special-image effects, affordable 3-D became associated almost exclusively with them. But advances in game-playing held little appeal for corporate IS. Business 3-D, representing the largest potential market, languished between the frivolous and the exorbitant.

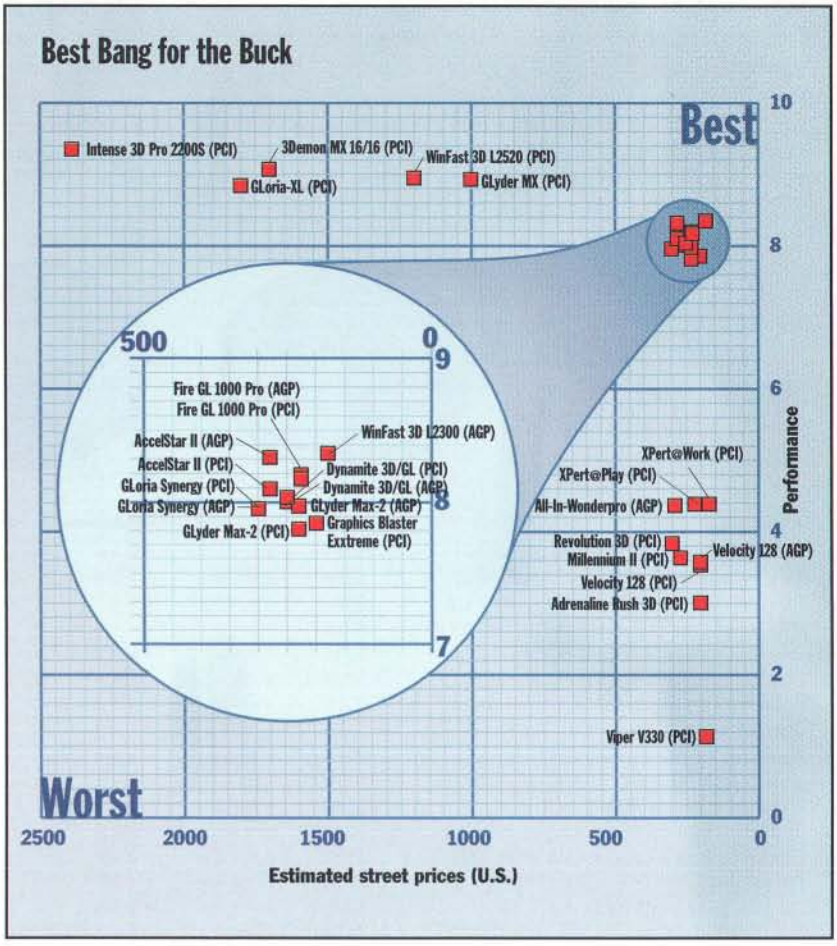
Today, we expect a video board to deliver capable SVGA operation, including higher resolutions and refresh rates. We expect accelerated 2-D Windows graphics and MPEG video playback. On top of that, we now want Direct3D and OpenGL acceleration with rendering options in hardware—a must if you want to get the most out of polygon-intensive visualization and modeling applications and even 3-D Web browsers.

Simply supporting 3-D functions in software is not the same as providing on-board hardware acceleration. And tossing a hastily written video driver into the mix can seriously hobble even the fastest hardware.

How We Rated

Choosing a 3-D video board is a three-step process. First you look for the fastest board. Next, you look at the fastest one that you can afford. Finally, you make sure you choose one that supports all the functions you need. That's the same line of reasoning we applied when we rated these boards on performance, price, features, and technology.

We selected our winners with three themes in mind: best overall mix of price, performance, features, and technology; best-performing 3-D card, regardless of price; and best value for under $300. To determine the Best Value score, we took the overall composite performance score and divided it by the cost of the board. As the basis for the Best Performance score, we looked exclusively at each card's raw performance score.



The overall score comes from a 50:25:20:5 weighted rating of performance, price, features, and technology, respectively (see the pie chart on page 115). Because performance is the yardstick by which graphics acceleration is measured, we gave it the highest weighting in our overall rating. We judged the boards both on time to complete a task and on frames rendered in a fixed time period.

To get a features rating, we evaluated each board against a matrix of expected features. We verified the presence or absence of a feature by testing and by studying a board's documentation. We then organized the features into categories, with each category and each feature within a category given a weight that contributed to a board's final features score.

Test Methodology

Makers of high-end 3D graphics accelerators typically quote performance as the number of primitives (e.g., triangles) drawn per second. These are numbers that, in the absence of additional information, such as the context, size, shading, color depth, and the smoothing method used to draw those triangles, make direct comparisons difficult.

In contrast, low-end board makers have traditionally judged their products' performance using business application–based benchmarks or tests designed to show their products' particular strengths. As these markets converge and high-end applications are pulled down to the desktop, the need for comparable benchmarks becomes crucial.

We defined our target environment as a high-performance workstation. Although used primarily for 3-D graphics, we expected this workstation to sup-

port occasional use of a standard office suite of applications. We selected a CLR Infinity PT2-DAX PC powered by a 300-MHz Pentium II with 128 MB of RAM. The system supported AGP and PCI slots, allowing both board designs to be tested. Our OS was Windows NT Server Build 1381, service pack 3.

Given the growing importance of OpenGL on the desktop (see the text box at right), we chose to characterize 3-D performance using the Viewperf benchmark (available at http://www.specbench.org), developed by the OpenGL Performance Characterization subcommittee. A portable benchmark, it's the current industry standard for evaluating OpenGL performance. The Viewperf test does not benchmark individual primitives; instead, it measures how well a system accelerates actual application data sets, called *viewsets*.

The CDRS viewset is derived from Parametric Technology's modeling and rendering software for computer-aided industrial design. The test measures seven different operations on a model of a lawn mower. The DX viewset is based on IBM's Visualization Data Explorer, a general-purpose scientific data visualization and analysis package. The DX benchmark draws a set of particle traces thorough a vector-flow field. Viewperf measures frames per second for each component test. The single result for each viewset is a weighted geometric mean. Each viewset comprised 40 percent of our final performance rating.

To measure 2-D performance of the boards when running common business applications, we used Bapco SYSmark for Windows NT. This benchmark suite, which comprises five application programs, measures the speed with which a system under test executes predetermined scripts of user tasks typically performed when using these applications. Our final performance scores weighted the Bapco results at 20 percent.

The application programs that we used to run the tests were Microsoft Word 6.0, Excel 5.0, and PowerPoint 4.0; OrCAD Layout Plus 7.0; and Welcom Software's Texim Project 2.0e. All these programs run in native 32-bit mode except PowerPoint, which runs the application code in 16-bit emulation mode.

As a processor-bound 2-D test running on 3-D graphics cards, Bapco served more as a reality check than a benchmark. We expected all the graphics boards in this roundup to provide competent 2-D Windows acceleration—and we weren't disappointed. Regardless of the chip set, bus, or on-board memory configuration used, all the boards turned in Bapco scores that were within 2 percent of the average.

It's only fair to note that Matrox disagreed with our use of Viewperf to judge the Millennium II, saying that the primary demand of the Millennium's target market—entry-level to midrange users—is fast 2-D performance. Matrox believes Viewperf is best used to measure the 3-D performance of more expensive, high-end boards used by graphics professionals. We believe that Viewperf remains a valid performance measure of any board that claims to support OpenGL, which the Matrox Millennium II does.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of NSTL's monthly PC Digest. *To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; 610-941-9600; fax 610-941-9950; on the Internet, editors@nstl.com. For a subscription, call 800-257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies, Inc.*

Graphics APIs Converge

What will desktop computing be like when millions of multimedia authors have access to the same technology that drives the creative engine at Industrial Light and Magic? What will product design be like when designers everywhere have access to the same large-model visualization and virtual prototyping on their PCs that were used to design the Ford Taurus and the Boeing 777?

Microsoft and Silicon Graphics, Inc. (SGI) representatives posed these questions when they announced their common vision to redefine the way in which developers create graphics applications. Called Fahrenheit, this set of three new APIs is expected to eliminate the need for programmers to write to both OpenGL and Direct-3D or choose between the two APIs (or OpenGL Optimizer and Hewlett-Packard's Direct Model) to determine which markets to go after.

The first new API is Fahrenheit SceneGraph. Expected to ship in early 1999, it exists as a layer (typically) between an application and the low-level graphics API. SceneGraph isolates the application from hardware and system details that are relatively exposed at the low-level graphics API level. By providing that isolation, it leaves application developers free to focus on the application and leaves out a lot of messy details about how to optimally use underlying hardware and system resources. It can also make full use of multiple processors in machines. The technology for this API is COM based and has been derived from SGI.

The second new API, which is an extension to SceneGraph, is known as the Fahrenheit Large Model Visualization. Expected to ship early in 1999, it will enable applications such as 3-D CAD software packages to take full advantage of the SceneGraph API.

Derived from SGI's OpenGL Optimizer and Hewlett-Packard's Direct Model technology, SceneGraph will be relevant to a wide variety of applications. It addresses incredibly large, complex data sets that include tens or hundreds of millions of polygons or triangles—or, more typically, hundreds of thousands or millions of complex mathematical surfaces.

One of the core technologies in this extension is representation, which searches in mathematical form rather than in polygonal form, allowing a system do tessellation dynamically on the fly. The extension is expected to be generally applicable; however, it's primarily designed to deal with problems that relate specifically to product design (e.g., automobile prototyping) and digital prototyping.

The third new API is the Fahrenheit low-level API. Expected to be available sometime in the year 2000, it sits on top of the hardware and will support applications ranging from games and entertainment all the way to scientific and advanced technical applications. The low-level API will be derived from Microsoft's Direct 3D and Direct Draw technologies, as well as from OpenGL.

The low-level API will also be fully backward compatible with today's Direct X5, Direct draw, and Direct 3D technologies. But for applications to take full advantage of the new capabilities that will eventually be introduced in the API, they will have to go through some changes—similar to the ones required during the migration from DirectX 1 through Direct X 5.

—Michelle Campanale

3-D GRAPHICS BOARDS FEATURES

Company	Product	Street price as of 1/14/98	Overall rating	Bus	Video controller or chip set	3-D noninterlaced resolution supported at true color (32-bit) up to:	Installed/ maximum RAM	RAM type
AccelGraphics, Inc.	AccelStar II	$279	★★★★	PCI	3DLabs Permedia 2	1280×1024	8/8	SGRAM
AccelGraphics, Inc.	AccelStar II	$279	★★★★	AGP	3DLabs Permedia 2	1280×1024	8/8	SGRAM
ATI Technologies, Inc.	All-In-Wonderpro	$279	★★★	AGP	ATI 3D Rage Pro	1024×768	4/8	SGRAM
ATI Technologies, Inc.	XPert@Work	$169	★★★★	PCI	ATI 3D Rage Pro	1024×768	4/8	SGRAM
ATI Technologies, Inc.	XPert@Play	$219	★★★★	PCI	ATI 3D Rage Pro	1024×768	4/8	SGRAM
Creative Labs	Graphics Blaster Exxtreme Professional Edition	$199.99	★★★★★	PCI	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Diamond Multimedia Systems, Inc.	Viper V330	$180	★★★★	PCI	nVidia Riva 128	1152×864	4/4	SGRAM
Diamond Multimedia Systems, Inc.	Fire GL 1000 Pro	$225	★★★★★	PCI	3DLabs Permedia 2	1600×1200	4/8	SGRAM
Diamond Multimedia Systems, Inc.	Fire GL 1000 Pro	$225	★★★★★	AGP	3DLabs Permedia 2	1600×1200	4/8	SGRAM
Elsa, Inc.	Elsa GLoria Synergy	$299	★★★★	AGP	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Elsa, Inc.	Elsa GLoria Synergy	$299	★★★★	PCI	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Elsa, Inc.	Elsa GLoria-XL	$1799	★★★★	PCI	3DLabs Glint MX	1920×1080	40/56	VRAM, EDO DRAM
Hercules Computer Technology, Inc.	Dynamite 3D/GL 6218GL	$249	★★★★★	PCI	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Hercules Computer Technology, Inc.	Dynamite 3D/GL 7218GLA	$249	★★★★★	AGP	3DLabs Permedia 2	1280×1024	8/8	SGRAM
B Intergraph Computer Systems	Intense 3D Pro 2200S	$2387	★★★★	PCI	Intergraph	1280×1024	16/32	SDRAM
Jazz Multimedia, Inc.	Adrenaline Rush 3D	$199	★★★★	PCI	Alliance AT3D, 3Dfx Voodoo Rush	1152×864	6/6	EDO DRAM
Leadtek Research, Inc.	WinFast 3D L2520	$1199	★★★★	PCI	3DLabs Glint MX, Glint Delta	1152×870	25/25	VRAM, EDO DRAM
B Leadtek Research, Inc.	WinFast 3D L2300	$169	★★★★★	AGP	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Matrox Graphics, Inc.	Matrox Millennium II	$269	★★★★	PCI	Matrox MGA-2164W	1600×1200	4 or 8/16	WRAM
Number Nine Visual Technology	Revolution 3D	$299	★★★	PCI	Number Nine "Ticket to Ride"	1280×1024	4 or 8/16	WRAM or SGRAM
Omnicomp Graphics Corp.	3Demon MX16/16	$1700	★★★★	PCI	3DLabs Glint MX, Glint Delta	1600×1200	16 or 32/48	VRAM, EDO DRAM
STB Systems, Inc.	Velocity 128	$199	★★★★	PCI	nVidia Riva 128	1600×1200	4/4	SGRAM
STB Systems, Inc.	Velocity 128	$199	★★★★	AGP	nVidia Riva 128	1600×1200	4/4	SGRAM
Symmetric (an STB company)	GLyder Max-2 GMA24A	$229	★★★★★	PCI	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Symmetric (an STB company)	GLyder Max-2 GMA24A	$229	★★★★★	AGP	3DLabs Permedia 2	1280×1024	8/8	SGRAM
Symmetric (an STB company)	GLyder MX GMX3A	$999	★★★★	PCI	3DLabs Glint MX, Glint Delta	1152×870	16/16	VRAM/DRAM

B = BYTE Best

✔ = yes; N/A = not applicable; INP = information not provided.

Warranty: P = parts; L = labor; F = freight to repair center; R = return to customer.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Supports DirectDraw	Supports Direct3D	Supports OpenGL	Application drivers supported over 1024×768	Warranty	Toll-free phone	Phone	On-line address	HotBYTEs
Win 95, NT	Win 95	Win 95, NT	AutoCAD; Win 95, NT	3/P, L, R	800-444-5699	408-546-2100	http://www.accelgraphics.com	1074
Win 95, NT	Win 95	Win 95, NT	AutoCAD; Win 95, NT	3/P, L, R	800-444-5699	408-546-2100	http://www.accelgraphics.com	1075
Win 95	No	No	AutoCAD; Win 95	5/P	See Web site	905-882-2600 ext. 4	http://www.atitech.com	1076
Win 95	Win 95	Win NT	AutoCAD; Win 95, NT, 3.1; OS/2 Warp	5/P	See Web site	905-882-2600 ext. 4	http://www.atitech.com	1077
Win 95	Win 95	Win NT	AutoCAD; Win 95, NT, 3.1; OS/2 Warp	5/P	See Web site	905-882-2600 ext. 4	http://www.atitech.com	1078
Win 95	Win 95	Win 95, NT	Win 95, NT	3/P, L, R	See Web site	405-742-6655	http://www.soundblaster.com	1079
Win 95	Win 95, NT 4.0 (software only)	Win NT	AutoCAD; Win 95, NT	5/P, L, R	800-468-5846	408-325-7000	http://www.diamondmm.com	1080
Win 95, NT	No	Win 95, NT	AutoCAD; Win 95, NT	3/P, L, R	800-468-5846	408-325-7000	http://www.diamondmm.com	1081
Win 95, NT	Win 95, NT	Win 95, NT	AutoCAD; Win 95, NT	3/P, L, R	800-468-5846	408-325-7000	http://www.diamondmm.com	1082
Win 95, NT	Win 95	Win NT	AutoCAD; Win 95, NT; OS/2 Warp	5/P, L, R	800-272-3572	408-919-9100	http://www.elsa.com	1083
Win 95, NT	Win 95	Win NT	AutoCAD; Win 95, NT; OS/2 Warp	5/P, L, R	800-272-3572	408-919-9100	http://www.elsa.com	1084
Win 95, NT	Win 95	Win NT	AutoCAD; Win 95, NT; OS/2 Warp	5/P, L, R	800-272-3572	408-919-9100	http://www.elsa.com	1085
Win 95	Win 95	Win 95	Win 95, NT	5/P, L, R	800-532-0600	510-623-6030	http://www.hercules.com	1086
Win 95	Win 95	Win 95, NT	Win 95, NT	5/P, L, R	800-532-0600	510-623-6030	http://www.hercules.com	1087
No	No	Win NT	Win NT	3/P, 1/L	800-763-0242	205-730-5441	http://www.intergraph.com/ics	1088
Win 95	Win 95	Win 95	DOS; Win 95, NT, 3.1; OS/2 Warp; SCO Open Systems X Window	5/P, L, R	888-568-3676	See Web site	http://www.jazzmm.com	1089
Win 95	Win 95	Win 95	AutoCAD; Win 95	3/P, L, R	888-532-3835	510-490-8076	http://www.leadtek.com	1090
Win 95	Win 95	Win 95, NT	AutoCAD; Win 95, NT	3/P, L, R	888-532-3835	510-490-8076	http://www.leadtek.com	1091
Win 95	Win 95	Win NT	AutoCAD; Win 95, NT, 3.1; OS/2 Warp	3/P, L, R	800-361-1408	See Web site	http://www.matrox.com/mgaweb	1092
Win 95	Win 95	Win NT	Win 95, NT	INP	800-438-6463	781-674-0009	http://www.nine.com	1093
Win 95	Win 95	Win 95, NT	AutoCAD; Win 95, NT, 3.1	2/P, L, R	800-995-6664	713-464-2990	http://www.omnicomp.com	1094
Win 95, NT	Win 95, NT	Win 95, NT	Win 95, NT, 3.1	Life/P, L, R	888-234-8750	972-234-8750	http://www.stb.com	1095
Win 95, NT	Win 95, NT	Win 95, NT	Win 95, NT, 3.1	Life/P, L, R	888-234-8750	972-234-8750	http://www.stb.com	1096
Win 95, NT	Win 95	Win 95, NT	Win 95, NT	3/P, L, R	See Web site	972-931-5999	http://www.symmetric.com	1097
Win 95, NT	Win 95	Win 95, NT	Win 95, NT	3/P, L, R	See Web site	972-931-5999	http://www.symmetric.com	1098
Win 95, NT	Win 95	Win 95, NT	Win 95, NT	3/P, L, R	See Web site	972-931-5999	http://www.symmetric.com	1099

PC EXPO in New York.

Where the corporate world comes to shop.

If you're a corporate professional looking for real solutions to your most challenging IT problems, PC EXPO is the one event that delivers all the goods.

More than 800 IT suppliers will come to PC EXPO with one thing in common: **corporate IT solutions – and to attend over 50 sessions within our Corporate Education Program.**

We deliver virtually every technology for serious profit – along with the resources and information you need to leverage them. From the desktop to the enterprise, it's all here. Hardware. Software. Peripherals. Notebooks. Servers. Storage. Networking. Telecommunications. Mobile/wireless. Computer telephony. NT. Java.

We mean all. Including an explosion of new Web and e-commerce solutions at our best-ever WEB.X – The Internet Event for Business, held concurrently during PC EXPO.

The world's full of IT events. But for corporate professionals, there's really only one. PC EXPO in New York.

To attend, call 800-829-3976, ext. 2980 or register online at www.pcexpo.com.

PC EXPO®

Exhibitors! Reach one-half-*trillion* dollars in IT buying power!

Call Geoff Poli at 800-829-3976 ext. 2930, or e-mail: gpoli@mfi.com

PC EXPO Exhibits • June 16-18, 1998 • Jacob K. Javits Convention Center • New York City
Corporate Education/Conference Program • June 15-18, 1998 • Held at the Marriott Marquis

Miller Freeman PC EXPO in New York is a registered trademark of Miller Freeman, Inc. • One Penn Plaza • New York, NY 10119

PC EXPO and WEB.X are registered trademarks of Miller Freeman, Inc. • One Penn Plaza - 11th Floor • New York, NY 10119 • 800-829-3976 ext. 2980 • 212-714-1300 • Fax 212-643-4802
PC EXPO is for trade professionals only. No one under 18 admitted. Your badge and carrier are non-transferable and will be confiscated and/or terminated upon any attempt to transfer or sell them.

Source Code: B

Multicast your data over IP waters and watch your bandwidth return manyfold. ***By Tom Shafron and Pete Loshin***

Multicast Offers Bandwidth Salvation

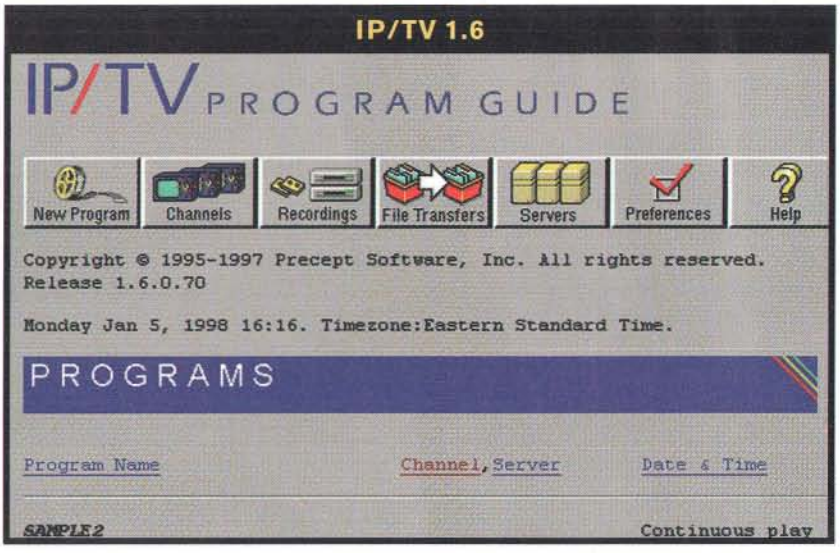
IP Multicast (see "Multicast to the Masses," June 1997 BYTE) offers network implementers a tool for curbing application-bandwidth piggishness. Although it's long been a part of the TCP/IP protocol suite (see the Tech Focus on page 124), it has also been hobbled by a catch-22: Network product vendors wouldn't always implement it correctly because there were no applications that required it, and application developers wouldn't build in support because users couldn't use it on their networks.

With the growing demand for bandwidth-hungry video and conferencing applications, things are now looking up for multicasting. IP Multicast offers the benefit of IP broadcasting—the ability to transmit data to lots of users in one fell swoop—without the disadvantages, which include the potential for monstrous network performance hits and the inability to cross IP routers.

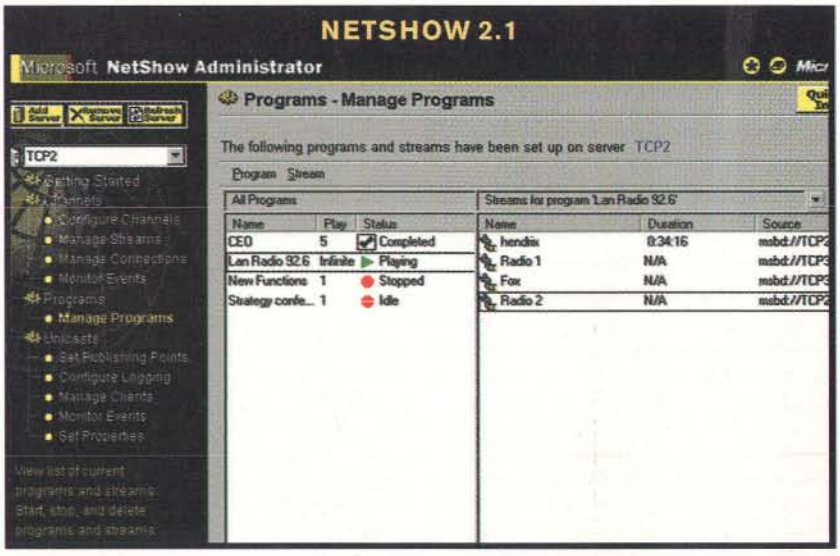
Any application that distributes lots of data can benefit from multicasting, but multicast-enabled products largely target the distribution of multimedia content, especially video. We looked at two products—Microsoft's NetShow 2.1 and Precept's IP/TV 1.6 suite—that offer video-content-publishing solutions. A third, StarBurst's Multicast 3.03, offers a heavy-duty solution for distributing meaty data files to lots of recipients without hacking away at the available bandwidth.

Let's Put On a NetShow

NetShow follows a Microsoft tradition: Build on what's available, make it yours, and make it less expensive. In this case, it's also free. To create NetShow, Microsoft bought all the code it could find, including codecs from Intel, Progressive Networks, VDONet, VIVO, and Voxware, and mixed them together with a splash of new Microsoft technology. This resulted in an effective content server, which is actually three separate servers: NetShow Server 2.0, NetShow Server with RealVideo, and NetShow Theater Server.



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★



After using NetShow for a while, we got the feeling that these three products could have been integrated into a single, more effective content server. *continued*

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

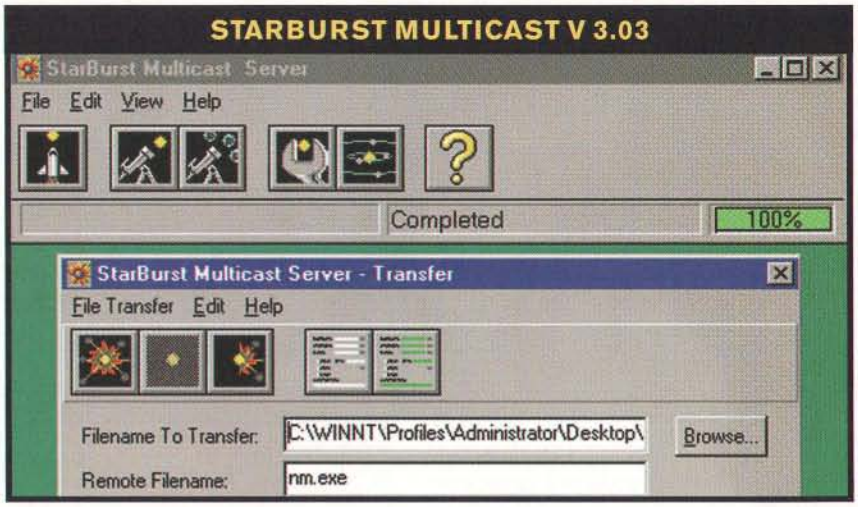
★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

NetShow runs only on Windows NT 4.0 Server and can be administrated from any Windows 95/NT system. One computer serves as the administrator for all the NetShow Servers on a network, as long as they can be accessed via a machine name or IP address. This is useful when distributing content via multiple servers.

NetShow Server 2.0 handles most multicasting via channels, although RTP audio, as well as files, can be sent. Channels provide all the necessary data for a client to receive and decompress a streamed multicast. Channel streams are made up of either data received from the included real-time encoder or Active Streaming Format (ASF) files, which might contain audio, video, images, URLs, and/or scripts. For live events, the feed is sent directly from the encoder to the server, which eliminates the step of rendering an ASF file.

For a multicast to reach a client, every router between the server and the client must be multicast enabled, so NetShow Server 2.0 has the ability to distribute content to other NetShow servers via a unicast stream, from which point the stream can be multicast across a network. Using this technique, companies can, in effect, multicast through an extranet without worrying about the routers in between. Precept Software provides a similar capability with its IP/TV suite.

In sum, NetShow is another powerful package from Microsoft, but it has a somewhat thrown-together feel. Typical for Microsoft is the attempt to move the industry toward a new and proprietary standard for content (the ASF file) along with a high-value proposition (distributing NetShow for free). Dealing with a relative lack of integration is the price developers must pay for the opportunity to use NetShow as a development platform for more sophisticated multicast applications.



RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★

Efficient File Delivery

Moving files from one system to another, which was once practically miraculous, now seems humdrum. StarBurst Communications makes file transfers interesting again for certain applications. Based on StarBurst's MFTP protocol, StarBurst Multicast 3.03 enables the "broadcast" of files from one source to any number of recipients without flooding intervening networks and systems with irrelevant traffic. MFTP reduces the time and bandwidth required to distribute files to many hosts.

MFTP relies on resource-hungry virtual circuits between the source and the destination to move data files. Each client makes a virtual circuit with the server, so even though file servers might handle 100 or more simultaneous sessions, each session gets only a fraction of the total bandwidth available. This causes problems when distributing a big file, such as a software upgrade or a price list, to many clients.

MFTP uses multicasting and UDP to effectively broadcast files to anyone who tunes in (or to only a predetermined group of recipients, if preferred). StarBurst Multicast servers send files to a multicast address once, and every system subscribed to that address receives the data. The protocol adds reliability—making sure that each recipient gets the whole file—by enabling recipients to report back to the server. After sending a file, MFTP provides a mechanism by which recipients negatively acknowledge (NAK) any part of the file they didn't get. The server resends those pieces that get NAKed and repeats the process until no one NAKs.

StarBurst Multicast was easy to install and simple to make work. However, the

Unicast, Broadcast, Multicast

IP defines three types of data transmission: unicast, broadcast, and multicast. Unicast, the direct transmission from one specific host to another, works well for reliable protocols, such as TCP.

Broadcasts originate from a particular host for reception by every other host on a network; once thought to be a good idea, the latest version of IP (IPv6) doesn't even support broadcasts. Every connected host on a network must process a broadcast, regardless of its relevance, which hurts the performance of individual systems. Furthermore, broadcasts work only on the local IP network because if routers forwarded them across an intranet or the Internet, the network would soon grind to a halt. Finally, broadcasts—which are easy to implement on Ethernets, where all hosts can sense a single transmission—chew through bandwidth on point-to-point networks. An example is ATM, where a special server retransmits the broadcast to every connected host.

Multicast uses a set of special addresses (see the Tech Focus on page 124) to which hosts listen for multicast packets. When a host sends a packet to a multicast address, all the hosts listening to that address get a copy of the packet. Thus, hundreds of hosts might receive a copy of a single packet sent by a server. This kind of setup works great on Ethernet LANs because any or all hosts on the LAN can listen to the multicast address, get the data being sent there, and keep the LAN traffic at a tolerable level.

Routing complicates matters, though, as routers must act on behalf of hosts listening to a particular multicast address when multicasts to the address occur outside the local network. The router becomes another host listening to the address, and other, more distant routers must also act on behalf of the local router to forward it copies of those multicasts. Despite routing issues, multicast more efficiently distributes data from one source to many, but not all, hosts in a network.

Learn valuable new skills at your convenience – on the Web!

Now, save time and money while you learn the skills you need to stay up to speed. Beat the competition for a new job, a promotion, or make a career change by learning the latest computer technologies and business management tools.

ACCESS COURSES 24 HRS/DAY, 7 DAYS A WEEK • STUDY COMPLETELY ONLINE
INTERACT WITH EXPERT INSTRUCTORS BY EMAIL • JOIN FELLOW STUDENTS IN ONLINE DISCUSSIONS

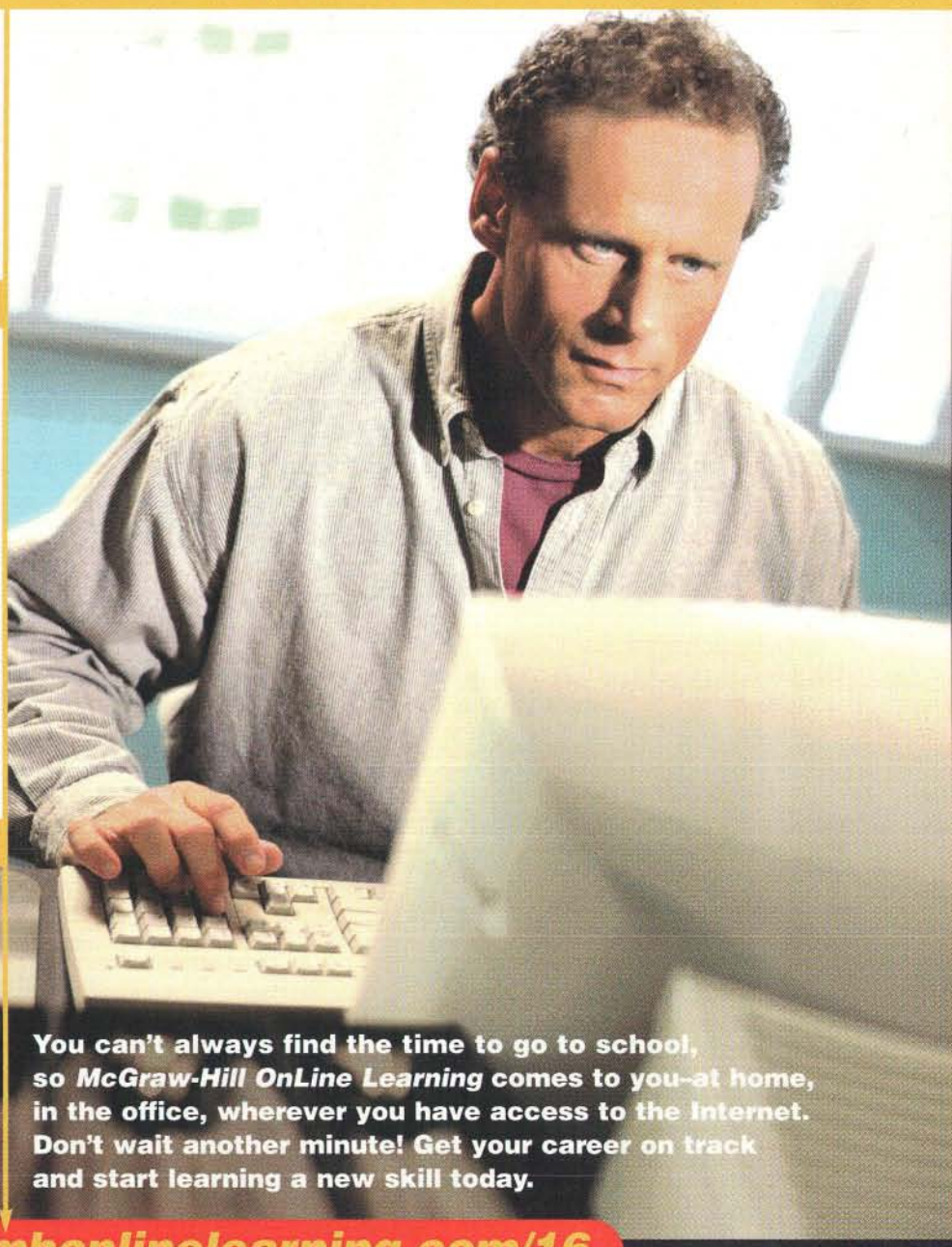
***McGraw-Hill OnLine Learning* gives you expert instruction, online support, dynamic graphics and audio lectures to make learning fun!**

Courses currently available include:

- Intro to the Internet
- Web Page Design
- Web Programming
- Creating Interactive Web Pages
- Windows NT Certification (Microsoft)
- Windows NT Server in the Enterprise (Microsoft)
- Windows 95 Certification (Microsoft)
- Networking Certification (Microsoft)
- Intro to Visual Basic
- Advanced Visual Basic
- Java Programming
- Programming in C++
- Effective Project Management
- Creativity & Innovation in the Workplace
- Stress Management
- Decision-making Skills

More courses are being added monthly!

Visit our site and sample the first module of a *McGraw-Hill OnLine Learning* course, absolutely free.



You can't always find the time to go to school, so *McGraw-Hill OnLine Learning* comes to you–at home, in the office, wherever you have access to the Internet. Don't wait another minute! Get your career on track and start learning a new skill today.

www.mhonlinelearning.com/16

McGraw-Hill OnLine Learning
KEEPING YOU UP TO SPEED

(800) 823-5737

105 YEARS OF EDUCATION EXPERIENCE

A Division of The McGraw-Hill Companies

Enter HotBYTEs No. 106 at http://www.byte.com/hotbytes/

package's GUI MFTP interface suffers from many of the same problems that early Windows-based FTP implementations had, including sometimes-unclear icons, a lack of drag-and-drop access to files, and a simplistic approach to GUI design. But according to StarBurst, most users bypass the relatively clunky GUI with scripts to automate their file transfers, or even to create their own UIs to handle, say, transfer-scheduling tasks.

Heavy-duty scalability (StarBurst claims to have simulated 50,000 clients in its labs) comes with a heavy-duty price tag, which starts at $40,000 for the server and 25 simultaneous client sessions. But if StarBurst Multicast has what it takes to get your job done, it's worth the price.

Precept IP/TV

Precept's IP/TV 1.6 suite includes IP/TV Program Guide, a program-administration tool accessed through a Web front end; IP/TV Video Server, a server that can multicast simultaneous video streams from canned AVI files or from live sources, including video cameras or videotape/disk players; and IP/TV Viewer, the client software that lets you select and view multicast video programs as well as manage your connections. The StreamWatch utility monitors live multicasts and provides tools for bandwidth control.

At first glance, IP/TV looks like another Windows-only product. The IP/TV Viewer and Video Server are available only for Windows 95/NT; the IP/TV Program Guide runs on either NT or Unix with a Microsoft, Netscape, or Apache Web server and provides access through any browser for administration. In fact, because IP/TV supports a full spectrum of standard video and multicast protocols, its components interoperate with any other platform that also supports standards such as the RTP protocol, which is used on the MBONE (the "multicast backbone" providing multicast services over the global Internet). This means that Macintosh users can access IP/TV programs with QuickTime TV and that any number of MBONE tools provide Unix accessibility.

The IP/TV Program Guide plays nicely with other multicasts, tracking MBONE or other RTP-compliant streams, listing them as programs, and pointing IP/TV Viewer users directly to their source. And the Viewer works not just with the IP/TV suite, but with MBONE and other RTP multicast streams. While the server interface is not always elegant, we installed Precept's complete IP/TV suite in less than an hour, with minimal help from the manuals.

While NetShow offers a good, solid foundation for building more-complicated video applications, IP/TV is a product that interoperates with non-Windows platforms and combines ease of use with sophisticated programming and scheduling features. For example, you can schedule programs for continuous play, use encryption and password authentication to protect your video streams, and even transmit application screens along with video for a simultaneous slide show with the SlideCast feature.

To Multicast or Not?

There might be only a few dozen multicast products commercially available right now, but the ranks are growing. The IP Multicast Initiative (IPMI), an industry group devoted to furthering IP Multicast, aids this growth. Its members include IBM, Microsoft, Netscape, Novell, Sun, 3Com, and many others.

The question is not whether you will use multicasting, but when. It will definitely be a part of your networked future. B

Tom Shafron is president of Polychrome Interactive, a New York new-media firm. Pete Loshin, a BYTE technical editor, is the author of Extranet Design and Implementation *(Sybex, 1997). They can be reached at* **ts@polyint.com** *and* **pete.loshin@byte.com**, *respectively.*

TECH FOCUS: ADDRESSING

Multicast Addressing

IP addresses fall into one of five categories. Classes A, B, and C refer to addresses within large, medium, and small networks, respectively; Class E addresses are reserved and currently undefined. Multicast, or Class D addresses, fall in the range from 224.0.0.0 to 239.255.255.255 and can be destination addresses only. No IP datagram can ever be originated from such an address; it can only be sent to it.

According to RFC 1112, which defines IP multicasting, the first address in the space, which is 224.0.0.0, is guaranteed to be unassigned; the next one, 224.0.0.1, is assigned permanently to all IP hosts and gateways with direct connection to the network. Furthermore, transmissions to multicast addresses from 224.0.0.0 through 224.0.0.255 are never forwarded by multicast-enabled routers.

The concept of multicast presupposes that hosts on the same link-layer medium (e.g., Ethernet) sense all network traffic and listen only to data addressed to them. Ethernet works this way; just as each host interface has a 6-byte media access control (MAC) address that becomes associated with the host's 4-byte IP address, there are also 6-byte Ethernet multicast addresses that can be associated with 4-byte IP multicast addresses. When routers forward multicast packets on an Ethernet network, they transmit to one of the Ethernet MAC addresses to which subscribers listen.

However, Ethernet is only one link-layer protocol. With the increasing popularity of point-to-point protocols, such as ATM, for IP networking an architecture must be created to allow connected hosts to use a server to mediate multicast reception. This mechanism uses a server that acts on behalf of connected hosts, registering multicast subscriptions by hosts on the network and relaying multicast transmissions directly to the subscribed hosts. Support for multicast over ATM relies on the Multicast Address Resolution Server (MARS), which is described in RFC 2022.

PRODUCT INFORMATION

IP/TV 1.6
$3995 for starter pack (includes 20 clients, server, guide, and streamwatch)
(Windows 95/NT for server; program guide on Unix/NT requires Web server)
Precept Software, Inc.
Palo Alto, CA
650-845-5200
fax: 650-845-5235
info@precept.com
http://www.precept.com
Enter HotBYTEs No. 1066.

NetShow 2.1
free
(Windows NT)
Microsoft Corp.
Redmond, WA
425-882-8080
http://www.microsoft.com
Enter HotBYTEs No. 1064.

StarBurst Multicast 3.03
starts at $40,000 for server and 25 simultaneous clients
(Windows NT or Unix for servers [clients on Win32])
StarBurst Communications Corp.
Concord, MA
800-585-3889
978-287-5560
fax: 978-287-5561
info@starburstcom.com
http://www.starburstcom.com
Enter HotBYTEs No. 1065.

at http:www.byte.com/hotbytes/

www.byte.com

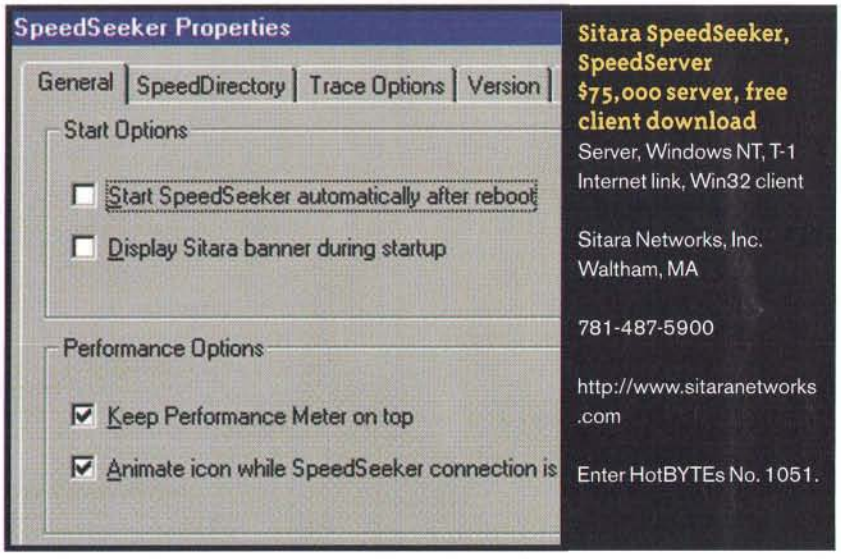
Sitara rewrites TCP to optimize Web transfers, offering ISPs a way to add value for a price. ***By Pete Loshin***

If You Build It, Will They Come?

The Internet world of open standards can sometimes be hard on software vendors. Wait patiently for finalization of the latest and greatest specification and you still have to slug it out with competitors who offer products that are essentially identical to yours. Vendors willing to gamble can score big if they sidestep the standards process by creating their own, as with Sun's Java, and hope the rest of the industry tags along for the ride.

Sitara Networks scrutinized the Transport Control Protocol (the TCP in TCP/IP) and decided there's a better way to deliver Web content. SpeedServer, Sitara's server product, and its client SpeedSeeker, incorporate a modified transport protocol that fixes some of TCP's more glaring performance problems (see the Tech Focus). Sitara, wagering that it can download Web content as much as three times faster than with traditional TCP—without adding bandwidth or using caches—hopes to win over Web publishers despite a proprietary solution and a high price.

The SpeedSeeker client, a free download, adds Sitara's new transport protocol to your system's network stack. The beta I tested, which includes Winsock 2.0, weighs in at around 2 MB, though the shipping version is expected to slim down to 850 KB. Publishers pay $75,000 for SpeedServer to operate between the Web server and clients and interface between the new transport protocol and HTTP.



Sitara's SpeedSeeker client software can supercharge downloads from enabled Web sites, but its interface is overly intrusive.

The server wasn't ready for review, so I tested with Sitara's SpeedServer-enabled Web site. Client installation (currently Windows 95 or NT only, with Netscape 3.x or 4.x and IE 3.x) was uncomplicated but intrusive. SpeedSeeker by default adds itself to the Windows taskbar and autostarts itself on boot-up (complete with an annoying splashscreen), but the user can modify that. Sitara needs to lower SpeedSeeker's profile even further to make it palatable to casual Web surfers.

Verifying Sitara's claims of up to three times faster downloads proved difficult due to what the company said were server problems. Results varied from as much as three times faster to as much as three times slower with SpeedSeeker. Once Sitara shakes the bugs out of the system, it should actually provide real value.

Should you try SpeedServer? The answer depends on several factors: how well the standards bodies fix HTTP, how many publishers and users take the Sitara plunge, and how much customers will pay for improved performance. The most important factor may be how many software vendors (particularly OS and browser vendors) incorporate Sitara's transport into products. By the end of the year we should know whether Sitara is insanely great or just another skid mark on the information superhighway. B

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★

TECH FOCUS

Doing a Job on TCP

TCP's performance with HTTP is hobbled by the way it ensures reliability. Hosts acknowledge (ACK) receipt of all TCP frames (which may be fragmented into several IP packets) by telling the sender the number of the last byte of data received. Any time a packet is dropped, all data since the last ACK is resent—even though most of that data might have already been received once. Sitara's transport protocol resends only the bytes that were missed.

Pete Loshin, BYTE technical editor for software reviews, wrote Personal Encryption Clearly Explained *(AP Professional, 1998). You can reach him at* **pete@loshin.com.**

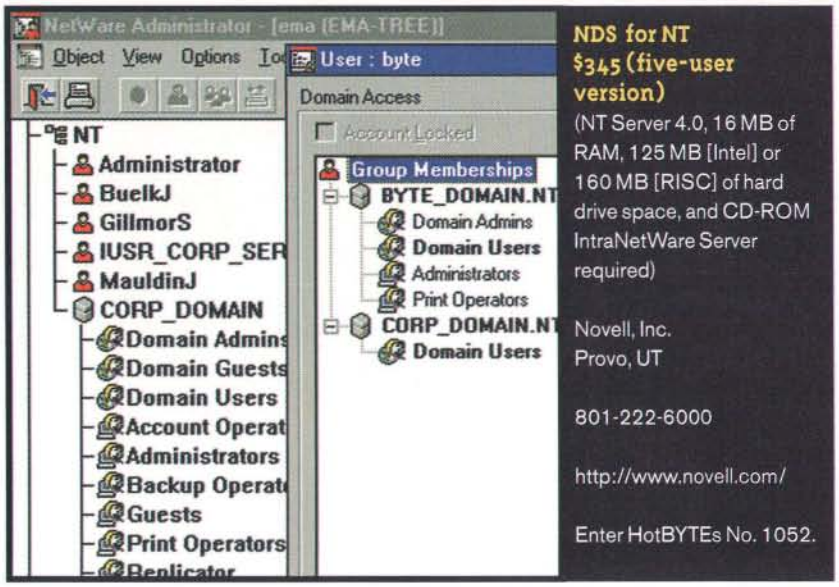
Novell goes for Microsoft's Active Directory jugular with an open solution to a big problem. ***By Steve Gillmor***

Novell's New Directory Direction

With the active universe holding its breath waiting for Microsoft's NT 5.0 and its Active Directory, Novell's Directory Services (NDS) for NT seizes the day by cleverly extending and embracing NetWare's flexible directory services for use within existing NT networks. Simple and seamless, NDS for NT helps reduce busy network administrators' work loads. The initial release requires a NetWare server, but an NT-hosted version will follow.

When you replace a DLL on your primary and backup NT domain-controller servers, NDS for NT seamlessly diverts all NT domain changes to and from itself for a single point of directory administration.

NDS for NT migrates through Windows NT domains with a two-stage installation process. The auto-loading CD installs IntraNetWare Client for Windows NT, reboots the server to load the client, and then launches the Domain Object Wizard. This Wizard moves existing NT domain users into the NDS tree, replaces the DLL that NT uses to query its Security Accounts Manager (SAM) database, and reboots once again to load the new NDS for NT redirector.



NDS for NT
$345 (five-user version)
(NT Server 4.0, 16 MB of RAM, 125 MB [Intel] or 160 MB [RISC] of hard drive space, and CD-ROM IntraNetWare Server required)

Novell, Inc.
Provo, UT

801-222-6000

http://www.novell.com/

Enter HotBYTEs No. 1052.

You use Novell's NWAdmin and the NDS for NT snap-in to manage user access to multiple domains through simple group memberships.

TECH FOCUS

Dealing with NT Domains

Windows NT denominates users by a security identifier (SID) for the NT domain plus a relative identifier (RID) for the user within that domain. NT grants access to resources based on the SID/RID pair, and NT resources migrating to NDS for NT retain their SIDs. NDS for NT generates a RID for each domain that an NT user belongs to and stores it under NDS's domain object. When the user logs in, NDS supplies the associated SID to authenticate the user. Administrators can manage multiple NT user instances as a single NDS user object.

With the original NT domain's information stored in an NDS distributed database, NDS captures all the calls originally destined for NT's SAM database. You can continue to manage your domain through native NT utilities, but you'll want to install Novell's NWAdmin and the NDS for NT snap-in to take advantage of combined NT/NDS administration. I created and managed users, groups, login restrictions, and passwords for IntraNetWare and NT resources alike.

Where NT administrators must add complex trust relationships to provide cross-domain access to their users, NDS for NT allows you to grant rights on a per-user basis. Moving a user from one domain to another no longer requires deleting and re-creating the account. Even better, you can provide access to multiple NT domains by adding users to an NDS domain object's group membership.

NDS for NT doesn't lack for compromises. For example, should an NT Service Pack overwrite the Novell-modified SAMSRV.DLL, NDS for NT reapplies the Novell version and eliminates any bug fixes in the Service Pack. Also, the extra round-trips to a NetWare server for login authentication increase network traffic, although this is offset somewhat by the lack of replication between NT's primary and backup domain controllers.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

At $69 per user, NDS for NT deserves attention. It lets corporations continue to support NT utilities and adopt NDS strengths without costly retraining. **B**

Steve Gillmor is a consultant for Southern Digital, Inc. (Charleston, SC). You can reach him at **sgillmor@southerndigital.com.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

NETWORLD+INTEROP 98

The Definitive Networking Event

Special ISP, CommUnity, Engineering and General Conferences

In-Depth Educational Tutorials & Workshops

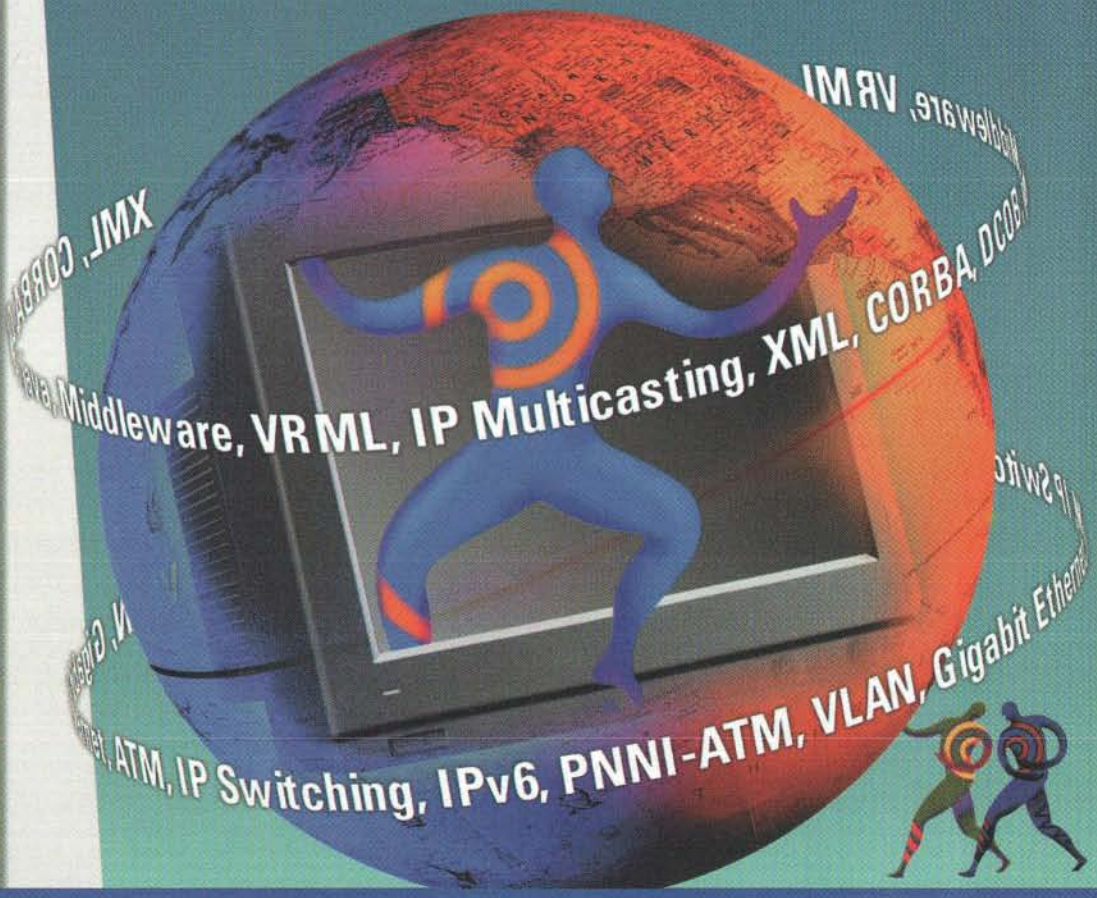
Over 600 Venders at the Exhibition

Register by April 5th and Save

Registration Info:
1-800-944-4629
International
650-372-7090
www.interop.com

THE WORLD OF TOMORROW IS HERE

LAS VEGAS, NEVADA · MAY 4-8, 1998



EXPERIENCE WHAT THE FUTURE HOLDS

I've Seen The Future
NETWORLD+INTEROP 98

In the world of tomorrow, people and machines will connect in new and seemingly unimaginable ways. You have an opportunity to see what the future holds May 4 - 8, 1998 in Las Vegas.

NetWorld+Interop is the definitive networking event bringing together over 600 of the world's leading technology vendors presenting products that are setting the standards for the 21st century. Workshops, conference sessions and tutorials conducted by celebrated industry leaders will provide you with a rare face-to-face opportunity to learn from the visionaries who will define the standards for the years ahead.

The centerpiece of NetWorld+Interop is the InteropNet™ – the world's largest short-term, real-time network. Networking masters collaborate to create a multi-layered, operational network that has more firepower than many small countries.

If the shape of the network, Internet, telecommunications and ISP future is important to you—this is the one event too important to miss!

HLIW8SPA

Microsoft restores Mac/Windows file compatibility with the latest rev of Office for the Macintosh. ***By G. Armour Van Horn***

OfficeMac: Worth Revisiting in 98

For a long time, Microsoft Word and Office were the essential cross-platform applications for workgroups that use both Wintel and Macintosh machines. Office 97 for Windows, with its incompatible file formats, ended the cooperation and left the Macintosh community waiting and wondering. After using a beta of Office 98 for the Mac, I'd say the wait was worthwhile.

Office 98 includes Word, Excel, PowerPoint, and Outlook Express, but not Access. Once again, the programs share file formats, and import and export filters are available on Microsoft's Web site. Microsoft has researched Mac users' needs, and the menus shouldn't upset the Macintosh faithful. Toolbars can be moved to any screen edge or configured as floating palettes.

Office 98 requires a PowerPC. I tested it under both System 7.6 and Mac OS 8. To be certain the code runs acceptably, the developers are benchmarking every build on the oldest and slowest Power Macintosh, the 6100/60.

There's a custom installer (plus an uninstaller), but you can also just drag a single folder from the CD to the hard drive. On first launch the program copies needed files to the System Folder. If any of those files are later damaged, Office replaces them on the fly.

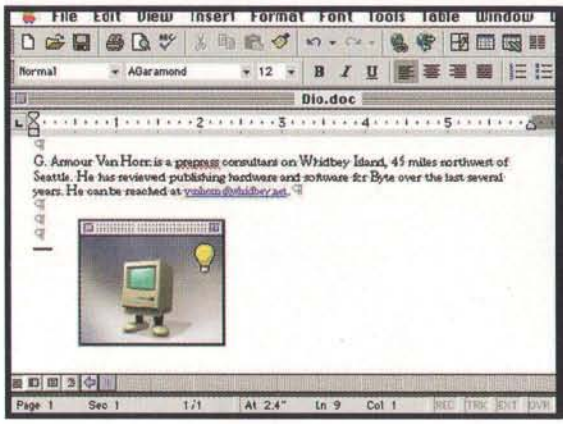
Few Office users know all that the programs can do. The Office Assistant and IntelliSense technology help by watching the user's actions and making suggestions. The Office Assistant gave me tips I would not have thought of by myself.

Several users can work collaboratively on a document, and Word preserves all versions, identifying each user's edits and providing a range of tools for combining revisions. Excel goes further, supporting shared workbooks so multiple users can open a single file; other users don't see updates immediately, but you can control the timing of saves.

Each Office application lets you "Save As HTML" and supports hyperlinks to other documents, document locations, or Internet URLs. Word can create, open, and edit HTML files; it won't replace dedicated HTML authoring tools, but it lets you prototype pages quickly.

The grammar checker, which operates during idle time, is the first I've seen that is consistently worth consulting. It identified my most frequent errors without flagging every sentence. Excel extends this to autocorrection of formulas.

Office 98 applications are large, but clever caching lets each start quickly. Word presents a quick WYSIWYG font menu, a pleasant departure from the previous version. In the early beta I tested, the product never seemed sluggish; it seemed to perform on par with the Windows version, Office 97. Loading HTML files was equally slow on both platforms. This new Mac release clearly matches the Windows version's functionality and restores the cross-platform operation we had with Mac Office 4.2.1 and Office 95. Those who held off moving to Office 97 to protect Macintosh compatibility can now move forward. B



Office 98 for the Macintosh
$499
(upgrade, $299)
(Power Mac)

Microsoft
Redmond, WA

425-882-8080
fax: 425-936-7329

http://www.microsoft.com/

Enter HotBYTEs No. 1062.

Word 98's UI is a Windows and Mac hybrid. Note the red-underlined dubious spelling and the automatically recognized Internet address.

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★ ★

TECH FOCUS

Installation and File Repair

In the past, a program installer loaded specific files into specific places. Renaming a hard drive could break these links, as could a single corrupted file. When an Office 98 application is launched on the Mac, however, it scans the system for needed resources, and if it doesn't find them, it reinstalls them. The installation process, essentially, places an "installation toolkit" on the hard drive so that anything needed is always available. A full Office installation thus weighs in at over 100 MB, but reduced support costs readily justify this.

G. Armour Van Horn is a graphic arts consultant on Whidbey Island, northwest of Seattle. You can reach him at **vanhorn@whidbey.net.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Jerry Pournelle

Chaos Manor

Doing Something About Microsoft

Jerry wants to leave the definition of "operating system" to Microsoft—but there's a catch.

Local and national papers are full of sound and fury denouncing Microsoft, but what it all signifies is a horse of another color. Unfortunately, it is very difficult to talk about Microsoft without triggering religious wars; but I don't think it can be avoided. There's too much pressure on government to "do something" about Microsoft, and that will affect all of us. Since whatever is done will be done on our behalf, it's important that we give this some thought and, with luck, come to some conclusions.

Start with my assumptions. They may not be yours, but think about them.

First, the industry has done pretty well without a lot of government intervention, and most government intervention in the computer business has done little good and much harm. This is hardly surprising given that most Congresscritters still don't know about e-mail.

Do you recall when the government poked around in the memory business? They ended up encouraging a cartel to charge us all higher prices for memory. Those were the days when clone makers competed by adding features to their systems. One feature was more memory. Higher memory prices helped keep computer prices up, aiding the big companies like IBM and hindering start-ups.

Fortunately, the government's effect was pretty short-lived. So far, Moore's law has guaranteed that computer capabilities have doubled every 18 months, and not even the FTC can do much about that, much as some of the old established outfits like the telephone companies wish they would.

Then there's the FCC, which insists that you meet its silly certifications for radio emissions, forcing us to have computer cases that seal up tight with stupid slots and grooves and slot covers. I say silly, because many of us run our machines with the covers off; but airplanes don't fall from the sky, and most of us don't even notice radio and television interference. If anyone has been arrested for running a machine without the cover on, I haven't heard about it.

The actual effect of the FCC regulations (besides providing jobs to regulators) is to make it much harder to enter the computer component business. Before you can sell anything, you must pay lots of upfront money to get FCC certification. This is good for the big established companies but hard on start-ups.

The industry has done pretty well without a lot of government intervention.

Adam Smith said that the worst enemy of capitalism is a successful capitalist, and the preferred method of capitalists who no longer love capitalism is to get the government to raise barriers to entry. Thus, my first assumption: we do not lightly invite the government into our industry. It's a lot easier to get the feds in our tent than to get them out again.

Second assumption: sometimes you have to invite the government in. David McCord Wright, one of my favorite economists, used to say that one reason Marx's analysis of the future of capitalism—more and more wealth concentrated in fewer and fewer hands—failed was the American antitrust actions. One need not be a big fan of government regulation to believe that monopolies are dangerous, and the government has both the right and duty to ensure competition. There's room for disagreement on just what constitutes a dangerous monopoly, but I think there's a wide consensus that sometimes there's a real need for trust-busting.

That doesn't mean you should lightly interfere with a successful company. Judge Learned Hand once said that having told a company to compete, we must not punish the company for successfully doing so.

Breaking up a successful company—say Microsoft, into Operating System and Applications companies—is not easy, involves massive confiscation of capital gains, and often leaves government watchdogs yapping at the heels of all the different branches. Witness Judge Green and the continuous involvement of the government in the affairs of the companies that used to be AT&T. You may have to resort to trust-busting, but it should be a last resort.

Third assumption: Microsoft's market share in the small computer world is getting up into the monopoly region. There's room for disagreement over whether it's at a critical point or not, but near universal agreement that any company with Microsoft's power in the OS field should not take unfair advantages in writing and marketing application programs.

In particular, Microsoft ought not use their dominance in the OS market to make it impossible for other companies to compete with Microsoft application programs. I've found there's surprisingly

PHOTOGRAPH: THEO FRIDLIZIUS © 1998

little disagreement with that position.

If we can agree on those three assumptions, I have a proposition for the computer community. We ask the Department of Justice to lay off Microsoft. In return, Microsoft agrees to fully document all API calls in all OSes it actively sells. In particular, if any Microsoft application designer uses or seriously contemplates using an undocumented feature or call, that fact will instantly be published (on the Web). As soon as possible thereafter, that feature or call will be publicly documented; and all Microsoft programmers will be instructed to implement this.

Note that this isn't all that onerous for Microsoft: if they're going to *use* those calls, it's much to their own advantage that they be properly documented. By making sure that their application programmers understand this requirement, they help their technical-support and interface people.

On the other hand, it levels the playing field for application designers, something Microsoft have always said they want to do anyway. Realistically, competing with Microsoft is always going to be a tough proposition, but it shouldn't be made impossible by giving them a head start on using undocumented features of the OS.

Another advantage of my scheme is that it leaves the definition of OS to Microsoft. One of Microsoft's contentions is that they have every right to improve the OS by adding new features, and doing that can't be in violation of the rather loosely worded consent decree they signed the last time the feds paid them a lot of attention.

Microsoft has a long history of integrating new functions into the OS.

The consent decree says that Microsoft can't require a computer maker or reseller to buy an application as a condition of getting the OS. This sounds clear enough until you think about it; but can they require you to include Internet Explorer 4, which is free?

Microsoft has a long history of integrating new functions into the OS, and I for one am glad of it. It was hard lines for Novell and Artisoft when Microsoft incorporated peer-to-peer networking into all the shipping versions of Windows, but it certainly was a good thing for me.

Now what if Microsoft claims that proper integration into the Internet requires a browser—Internet Explorer 4, again—to be an integral part of the OS? Some say that's a reasonable thing to claim; others say that browsers are definitely applications and in no way belong in the OS.

My proposal would take care of that. If Microsoft insists that an application is part of the OS (and thus must be shipped with the OS whether the computer vendor wants to or not), it will have to be documented like the OS: file formats, hooks, calls, features, DLL hooks, the whole ball of wax must be published. (And here's an interesting wrinkle: at press time, Netscape announced plans to make their browser source code public, beginning with the first Communicator 5.0 developer release.)

I'll leave the details to people more technically competent than me; but it does seem to me this is one way to get the lawyers and the government and, worse yet, the government lawyers out of our business, so that the resources they absorb can go into making computers faster and better and cheaper. If you like my idea, let Microsoft know. Now back to computing at Chaos Manor.

This month's tale of hope and glory started when I came back from a series of trips and turned on my computers. Princess, my Compaq Professional Workstation 5000 with dual 200-MHz Pentium Pro processors, came up all right, but when I tried to access the Internet, she reported that she didn't have a modem.

I'm not used to problems with Princess. She runs Windows NT 4.0, and, except for trips, she's never turned off. She does all my communications and most of my calculations, serves as the master control station for my networked computers, designs my Web pages, stores my digital pictures, and in general has become indispensable.

At this point, I did a foolish thing: I forgot Pournelle's laws, one of which states that if you have a computer problem, check the cables first. I didn't do that. Instead, I went mucking about in the software trying to see what was going on.

I thought I hadn't changed anything, but

You've already heard that...

MicroGuard Copy Protection is

UNBEATABLE

So...Here's how you can reach us:

www.micromacro.com

SEE YOU AT: CeBIT HANNOVER

International
Micro Macro Technologies, Ltd.
3 Hashikma St.
P.O.Box 11516, Azur 58001
Israel
Tel: (972-3) 558-2345
Fax: (972-3) 558-2344
E-mail: info@micromacro.com

USA
MicroGuard
631 South Pontiac St.
Denver CO. 80224
USA
Tel: (303) 320-1628
Fax: (303) 320-1599
E-mail: usa@micromacro.com

MICROGUARD

Charter member Pirate Busters
MICROSOFT® WINDOWS® COMPATIBLE
Mac OS

®MicroGuard and MicroGuard PC are registered trademarks of Micro Macro Technologies, Ltd. All other product names are trademarks of their respective owners. Mac and the Mac OS logo are trademarks of Apple Computer, Inc. Windows and Flying Windows logo are trademarks of Microsoft Corporation.

apparently I did. When I did come to my senses and checked cables, I discovered that while I was gone, the housekeeper triumphantly used the opportunity to get behind all my systems and thoroughly clean my office. In doing that, she managed to knock loose the cable that connects my U.S. Robotics 56-Kbps Sportster external modem to the serial cable port. Evidently, I hadn't screwed it in properly.

Both of Princess's serial ports are in use. One goes to the Sportster modem; the other goes to the Wacom ArtZ II drawing pad that serves as both an art input device and a mouse pad (both the mouse and the ArtZ II are connected; they don't fight unless you foolishly leave the Wacom pen on the pad and then try to control things with the mouse). I found the modem cable, reconnected it, tried the modem without success, and rebooted into NT.

NT is very good about reporting problems. "One or more processes did not start properly. Check the event log for details." The event log told me the modem software wasn't initializing properly; also that the serial ports were claiming overlapping I/O port numbers. I mucked about for an hour or so. At the end of that time, I was no better off than when I started.

Time to think. First thing: reboot Princess into Windows 95. Aha! Both the modem and the ArtZ II pad are working properly. There's no hardware problem. NT is just confused. Piece of cake. Only, of course, it wasn't: rebooting into NT left me where I'd been the last time, a conflict of serial ports and no modem.

Time to be systematic. First, remove the modem drivers and fool Princess into thinking she didn't have a modem. Next, reboot into Windows 95, see that both devices are working properly, go into System Manager, and record precisely which interrupt request (IRQ) and port number each wants. Then boot up in NT, reinstall the modem and pen devices, and manually force each into the values reported by Windows 95.

Reboot again.

Voilà. After working for what seemed like all day, I was back where I'd expected to be just after I turned Princess on.

Then I changed monitors on Fireball, and his Ethernet and sound cards both died. Fixing that one required physically removing those devices and reinstalling.

The moral of this story is that Plug and Play is not ready for prime time. Before shutting down any working computer,

Enter HotBYTEs No. 105 at http ://www.byte.com/hotbytes/

c-tree Plus®
COMMERCIAL
Database Engine

Speed is essential in all database projects, but not at the expense of stability. You wouldn't try to go 100 miles per hour with your bicycle! The same is true in database technology. FairCom has been delivering fast, safe, full-featured database engines to the commercial marketplace for 19 years. Proven on large Unix servers and workstations, c-tree Plus's small footprint and exceptional performance has also made it the engine of choice for serious commercial developers on Windows and Mac. Check out www.faircom.com for detailed information. You'll be glad you did.

c-tree Plus® key features for $895:

- Royalty Free
- Portable Multi-Threaded API
- Complete C Source
- Thread Safe Libraries
- Standalone or Client/Server
- Complete Transaction Processing, including automatic recovery
- Save-points
- Abort/Commit
- Roll-forwards /Roll-backwards
- Easy make system
- Advanced Variable Length Records
- BLOBS
- Space Management
- File Level Security
- Conditional Index
- ODBC/Java Interfaces
- Over 25 Developer Servers included

Platforms:

MIPS ABI	DEC Alpha	Sun SPARC	Windows 95	SCO	Banyan VINES
88OPEN	OSF/1	DOS	Windows NT	Linux (Alpha/Sparc/Intel)	QNX
AIX	HP9000	OS/2	Windows 3.1	AT&T System V	Chorus
RS/6000	Sun OS	Mac	Interactive Unix	Netware NLM	Lynx

FairCom® Server
DEVELOPMENT SYSTEM

Half of your Client/Server project is the Server! You control 100% of your Client Side. Why settle for less on your Server side? Move your functions to the server-side to decrease network traffic and increase performance!

Today's database demands may often be too complex for traditional Relational Model Database Servers. Server needs come in many different sizes and shapes. What better way to accommodate these requirements than by allowing the developer to take full control of the Server side? FairCom's Server Development System was created to meet this need. It provides the developer the means to create an industrial strength Server. Complete make-files are included for all FairCom commercial platforms. With our proven kernel add or override existing database functionality or create your own special multi-threaded server:

Application Server	Network Gateway Server	Data Warehouse
Special Web Server	Departmental Database Server	Embedded Servers

FairCom Server Development System key features:

Provides complete source code for all the interface subsystems to the FairCom Server. Server mainline, Communication, Threading, Remote function interfaces and procedure calls are all supplied in complete C source code together with the FairCom Server sophisticated thread-safe kernel libraries.

Customizable Transaction Processing	Rollback-Forward	Data History	Conditional Index
Online Backup	Anti-Deadlock Resolution	Multiple Protocols	Small Memory Footprint
Disaster Recovery	Client Side Source	Heterogeneous Networking	OEM pricing
	Multi-threading	File Mirroring	ODBC/Java interface
			Key level locking

www.faircom.com
FairCom® corporation
Commercial Database Technology. Since 1979.
USA. 800.234.8180
Phone: USA 573.445.6833 · EUROPE +39.35.773.464 · JAPAN +81.0592.29.7504 · BRAZIL +55.14.224.1610

make a rescue disk copy of all system software. Be prepared to use that disk. You have been warned.

Last month I told you about FreeSpace, from Mijenix. Since then, I've learned a bit more. FreeSpace is a selective file and folder compression program: you can use it on some files and not others. My recommendation is that until you're quite comfortable with it, don't use it on files you simply can't stand to lose.

If you are building a Pentium II system using the LX chip set, be extremely cautious.

It's a small memory-resident program that decompresses files on the fly. It does this so well that you don't really notice that it's there. Select and view those files with, say, Norton Commander for Windows 95 or Commander and QuickView, and you won't have any inkling that they're any different from any other files. You can edit them and run them if they happen to be programs; it won't matter.

I confess some residual doubts about the safety of compression programs. However, having said that, I've been running FreeSpace for six weeks now, and aside from having more disk space, I don't notice that it's there. I wouldn't recommend using it in systems with less than 32 MB, but then I don't recommend running Windows 95 with less memory than that anyway, and 64 MB is better.

FreeSpace is the second product from Mijenix; their flagship program is Zip Magic. Most of you know that I have long been a fan of WinZip; now it looks as if I'll be a convert to Zip Magic (hereafter referred to as ZM). ZM installs painlessly, with no need to reboot. When it's done, your ZIP files are transparent. Look at them with Explorer, and you'll see their constituent files. You can load, edit, execute, as if they weren't zipped at all.

Now true, you can do much of this with Norton Commander and WinZip. For that matter, Canyon Software's Drag and Zip utility has many useful features similar to ZM; but ZM, being memory-resident, makes it all even more transparent.

Moreover, it works with other compression formats, including the CAB format Microsoft uses for Windows components. If you double-click on a CAB file in Explorer, you'll see everything that's in it. If you need to restore a corrupted file, you can copy it, saving a lot of time over reinstallation. All told, ZM sets a new standard for archive management software.

The ZM manual says it requires 8 MB of memory. This is fine if it refers to running in Windows 3.1, but anyone running Windows 95 in 8 MB of memory is probably doomed to mysterious events, including crashes, even without adding a memory-resident program, however small. Of course, memory is cheap, and with 32 or more MB you won't have any problems, even with both ZM and FreeSpace installed; or at least I haven't.

Due to sloth (and that WinZip is pretty good) I came late to ZM, not trying it until I'd had experience with FreeSpace; but I have had no problems with ZM, and the few I've heard about from other users haven't amounted to much. Like FreeSpace, this seems to work like magic, and it won't take you long to forget it's there, even when you're using it. Mijenix seems to have a really good understanding of the way Windows 95 works.

Just be sure you have enough memory—but you should do that anyway. The real secret to painless working with Microsoft products (including plug-ins to Windows 95) is to have lots of memory. Fortunately, that's fairly easy to do now.

And having said that, let me add a caution. It used to be that memory was memory; so long as it met the timing specifications, it would work, especially if you bought from a brand name such as Kingston. No longer. Larry Aldridge of PC Power & Cooling warns that if you are building a Pentium II system using the LX chip set, be extremely cautious. Find out from your motherboard manufacturer precisely what make and model of memory-chip boards are known to work with that particular motherboard, and get that memory and no other. Note that memory that works with Intel motherboards very likely won't work with Hewlett-Packard boards, and vice versa.

Worse, the failure modes are intermittent and generally not repeatable. You may—probably will—get mysterious lockups and crashes and generally weird behavior, even with memory that seems to meet or exceed the SPD and JEDEC standards, if it's not the exact memory specified by the board manufacturer. If that's all Greek to you, don't worry about it. Just be very careful to get memory that has been tested and recommended by the motherboard maker.

If you're building a Pentium II system, you will also need an OS patch that will let it recognize the added controllers present in LX systems. As an example, without that patch, the system won't know about the universal serial bus (USB) and will often exhibit bizarre operating characteristics. The patch is usually supplied on a floppy disk by the motherboard maker; be sure to get and use it.

We're about to build a Pentium II system here at Chaos Manor. I'll have more to say on this after we've done it. If you get one running first, let me know what happened.

If you use NT, you need Diskeeper 3.0. It's the only disk defragmenter for NT that I currently recommend. Diskeeper installs simply and quickly, runs in the background, can be scheduled to run daily, and appears to be utterly safe. Clearly, I have no way to guarantee the safe part; but I have been using it for more than a year on my big server as well as on all my NT workstations, Alex has it going for most of his clients, and we have had no problems whatever, nor have I any reader reports of problems.

Disk defragmenters aren't very romantic, but they are necessary. Disk fragmentation can not only slow things down, but actually cost you disk space.

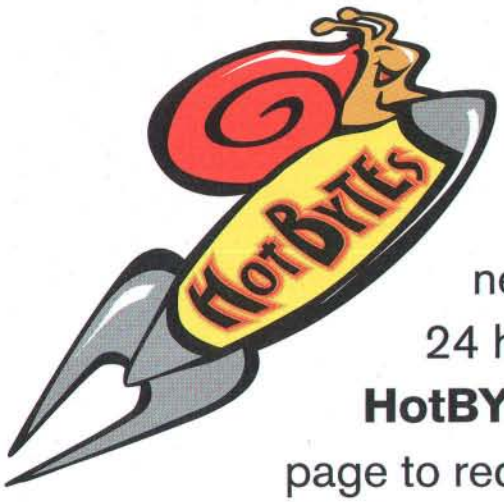
Diskeeper 3.0 is for NT only (there is a version 7.1 for VMS). As I have previously reported, for DOS and Windows 95, I like Golden Bow Systems' Vopt. There are probably other reliable defrag programs out there, but these are the ones I use, and they're good enough. Recommended.

The U.S. has more lawyers than the rest of the world. I don't have to join the ranks of the "Let's kill all the lawyers" crowd to think there may be a few of them interested in drumming up business. It's interesting that the vast increase in supply hasn't produced a corresponding fall in prices; if that reminds you of the Adam Smith quote I gave earlier, perhaps it should. In any event, it has long been in the interest of most members of the legal profession to restrict access to legal information not mediated by lawyers.

Of course, there are a few rebels. You

www.byte.com

Get the product information you need, when you need it, now!



Introducing **HotBYTEs**, our new product information server. **HotBYTEs** gives you fast access to the product information you need from one convenient source, 24 hours a day. Simply click on the **HotBYTEs** link from the BYTE Site home page to request the latest product information from BYTE advertisers and companies mentioned in the pages of BYTE. Product information will be rocketed to you via e-mail, the web or traditional mail. Powerful search capabilities allow you to find products by company, reader service number or category.

Quit waiting for product information to arrive by snail mail, carrier pigeon or the pony express. Try **HotBYTEs** today! No hassles, no stamps or long waits–just free product information–***FAST*** at **www.byte.com/hotbytes/**

BYTE

A Division of The McGraw-Hill Companies

can find some of the best material at Nolo Press (http://www.nolo.com). Nolo has long published books exposing some of the arcana of the legal profession, making access to the law available at nonlawyer prices. They have software for making wills, forming corporations, patenting software, prenuptial and even pre-living-together agreements, sales, and much more.

Their latest is Small Business Legal Pro 3, a CD-ROM containing six legal books on small business activities, from tax law to marketing to using small-claims court. I'm not advising small business start-ups to do without legal advice, but I'm quite certain you can use these books as a good start. The best way to save money on legal fees is to have your case organized as well as you can before you start paying for billable hours; this CD is nearly certain to save you far more than it costs. Recommended, and while you're at it, get Nolo's catalog and get on their mailing list. It's worth it for the lawyer jokes alone.

I am still playing last month's runner-up game of the month, Interplay's Fallout, a post-atomic war role-playing game. I have to say it hooked me: my character is now powerful enough to not be in much danger, but I have acquired a nonplayer character dog. I seem to have made it a major goal to get through the game without letting the dog get killed, which isn't easy since he loyally attacks anything that menaces me.

When I wrote about this last month, I railed against DOS games now that Windows 95 exists. In fact, Fallout is a Windows 95 game that has a way of running on DOS machines. It runs right out of the box in Windows 95; right now, it is my choice of role-playing game of the year.

The game of the month is The Great Battles of Alexander, from Interactive Magic, the best classical era war game I've ever come across. It has all the look and feel of a good miniatures game, as well it should, since it's adapted from tabletop gaming rules.

In classical era warfare, the casualty counts were extremely one-sided, because the actual battles were rather short—hand-to-hand combat in bronze armor is tiring—and usually ended when one side broke and ran. Most casualties were then taken by the loser in the pursuit. (It's an old military maxim: battles are won in the battle line, but victories are won in the pursuit.)

Miniatures war games have very complex formulas for determining the outcome of battles through morale checks. Morale-check factors include such things as can you see enemies fleeing or friendly troops routed, are you in communication with your leader, etc., as well as how many losses the outfit has taken. All this tends to slow things down, so that tabletop games often consist of 10 minutes of movement and 40 minutes of calculations.

The Great Battles of Alexander keeps the complex calculations, but they're all done very rapidly behind the scenes; what you see is the clash of spears and push of pikes, and then the results: casualties (your formation gets smaller), and one side (rarely both) may break and run. The game is simple enough to play, but winning is none so easy: Alexander has better troops than his enemies, but usually fewer of them, and you can't afford to make many mistakes. If you like classical era war, you will love this.

Once you go to a 21-inch screen, you will never be satisfied with anything smaller.

The computer book of the month is the "Special Edition" series of Que's *Using* books. The one I have in mind is *Using Java* by Joseph Weber (ISBN 0-789709-368), but all of them are good. Books in the *Using* series tend to be rushed out at the same time as the products. While they're often quite good, I tend to find *Learn X in 21 Days* titles better organized for first looks. Later, though, when you need explanations and some of the professional-level details, the Special Edition *Using* books pull ahead; or so I find. Anyway, Special Edition *Using Java* is useful as a reference and a learning guide, with many examples.

The book of the month is by Chaim Herzog and Mordechai Gichon, *Battles of the Bible* (Greenhill Books, ISBN 1-85367-266-1), a 1997 reissue of an 1978 book. Herzog is a former Israeli general who made use of his Biblical knowledge in the Arab/Israeli Wars: the strategic terrain has not changed much in 2500 years. The book traces all the known Biblical battles, including some previously thought to be legendary, shows the terrain, and examines what may have happened. It's fascinating reading. One caution: there are some good detail maps, but there's no good strategic map. If you get this book, you may want a good Old Testament atlas.

Chaos Manor is filling up, mostly with excellent software and equipment. Prominent among new arrivals is a 21-inch Eizo monitor; you may or may not know that Nanao is the parent company of Eizo. For a long time, my 15-inch Nanao was the best monitor in the house. Then I switched to 21-inch ViewSonic monitors, a move I have never regretted. Now, Nanao/Eizo is doing a great job of winning me back. I'll do some more tests, but to me the bottom line is, if you mostly do text and line drawing (e.g., CAD), you'll find ViewSonic more than good enough; but if you need really great color fidelity, you may want to spend the extra bucks on Nanao/Eizo. Either way, once you go to a 21-inch screen, you will never be satisfied with anything smaller. Trust me.

Next month, the Chaos Manor Users Choice awards and the annual Orchids and Onions parade. Stay well. B

PRODUCT INFORMATION

Diskeeper 3.0
Server $399
Workstation $75
Executive Software
Glendale, CA
800-829-6468
818-547-2050
fax: 818-545-9241
http://www.execsoft.com
Enter HotBYTEs No. 1047.

The Great Battles of Alexander $39.95
Interactive Magic
Research Triangle Park, NC
800-559-0434
919-461-0722
fax: 919-461-0723
http://www.imagicgames.com
Enter HotBYTEs No. 1048.

Small Business Legal Pro 3 $79.95
Nolo Press
Berkeley, CA
800-992-6656
510-549-1976
fax: 510-548-5902
http://www.nolo.com
Enter HotBYTEs No. 1049.

Zip Magic 1.0 $39.95
Mijenix Corp.
Boulder, CO
800-645-3649
303-245-8000
fax: 303-245-8111
http://www.mijenix.com
Enter HotBYTEs No. 1050.

at http://www.byte.com/hotbytes/

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, 29 Hartwell Ave., Lexington, MA 02173. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can contact him on the Internet or BIX at **jerryp@bix.com.** *Visit Chaos Manor at* **http://home.earthlink.net/~jerryp/.**

www.byte.com

MARCH 1998, VOL. 23, NO.3

BYTE

BUYER'S GUIDE

Essential Products and Services for Technology Experts

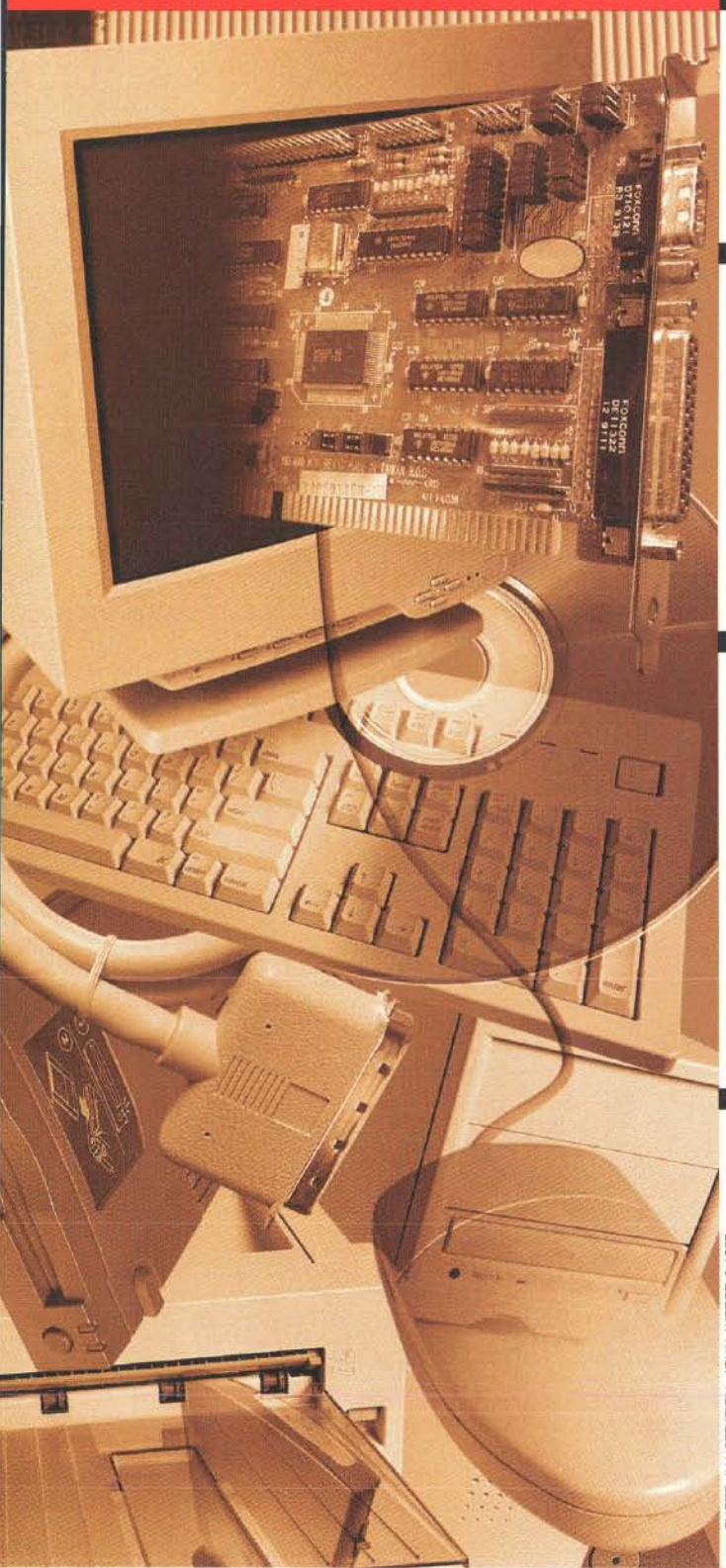


PHOTO ILLUSTRATION: JOHN WEBER © 1997

Mail Order

Top mail-order vendors offer the latest hardware and software products at the best prices. Page 136

Hardware/Software Showcase

Your full-color guide to in-demand hardware and software products, categorized for quick access. Page 144

Buyer's Mart

The BYTE classified directory of computer products and services, by subject so you can easily locate the right product. Page 148

Custom ULTRA 2 SCSI Cables - Terminators - Cases

If you want Ultra SCSI Performance use our Teflon Cables & Active Terminators. Our knowledgeable SCSI Technicians will solve all your SCSI problems...guaranteed!

SCSI Vue™ Active Terminator

From: $59

Four models available with optional Remote LED Pak. These are the finest terminators available, they fix SCSI problems and improve reliability.

Benefits:
- Improves SCSI Bus Performance
- Less Errors; More Reliable Data Transfer
- Diagnoses Problems • Analyzes Signal Quality

Features:
- Active Regulation • *Fast 50 & Fast Wide 68*
- Status Indicators • Gold Contacts

Active 2-1 SCSI Switch / Repeater

Benefits:
- Up to 14 Devices to 1 Computer
- Share Devices Between 2 Computers

Features:
- 2-1 Active Digital Switch/Repeater
- Regenerates SCSI Signal for Long Runs

From: $599

Gold Diagnostic Adapters

Styles: Gender Changers
- Both 50 pin and 68 pin (all combinations)

Styles: 68 pin Drive to 50 Bus
- 68 Pin Drive to 50 Pin IDC (runs wide drive as narrow)

Styles: 68 Pin Adapter Wide to 50 Pin Narrow
- 68 Pin External Adapter to 50 Pin (converts Host Adapter)

$49

Styles: For Adaptec Ultra Wide Cards
- Adapters with partial termination built in for 68 to 50 converters (converts Host Adapter)

$9

25 Pin Male to Male or 25 Pin Female to Female

Styles: Custom Adapters and Connectors that match most needs. If we don't have it we can make it.

From: $29

$39

Styles: Converts the 68 pin connector on a 68 pin cable to a 50 IDC female connector so that a 50 pin drive can be used on the 68 cable.

Styles: Converts the 80 pin SCA type drives to be used with either 50 or 68 pin SCSI Buses. Three models available.

From: $39

Drive Bracket Kits- 3.5" to 5.25"

From: $10

We carry a variety of Brackets that allow you to mount a 3.5" drive into a 5.25" bay. They include all screw and hardware necessary. Face panels are also available. Also see our Bay Cooler Fan and Bracket Kits.

Hot Swap Powered Terminator

$69

Now you can safely remove any SCSI device from a SCSI chain by simply clicking a switch. The Hot Swap Powered Terminator also has an optional Power Supply so that it can supply termination power to portable setups or when termination power is not being supplied.

View of the circuit board

Ultra 2 LVD Wide Terminator

This is the ultimate terminator on the market. It offers both Ultra 2 (LVD) operation and standard Ultra Wide or Fast Wide operation, all in one unit. Automatically senses which type of bus you are using and configures itself to that bus. Add our unique diagnostic capabilities and you have the ultimate terminator. Optional remote LED pak is also available. Just plug it into the front of the terminator and then mounted it on the front of your computer or monitor. Allows for easy monitoring of the SCSI bus.

$149

SCSI Vue™ Gold Diagnostic Cables

Benefits:
- No Loss Of Important Data
- Faster Performance
- Test Cable Integrity

Features:
- Diagnostic Indicators • Large Ferrite Filters
- Triple Shielding (Unique Design)
- Double Gold 20u" Plated Connectors
- Extra Heavy 26 Gauge Wire • 100 Styles in Stock

From: $39

Teflon® 90 Ohm External Cables

From: $159

Benefits:
- Ultra SCSI 40 MB/s operation
- Fixes Ultra SCSI Cable Problems

Features:
- Perfect 90 Ohm Impedance Match
- Triple Pronged Connector With Gold contacts

Gold .8mm Ultra SCSI Cables

Benefits:
- Faster Performance
- Test Cable Integrity
- No Loss Of Important Data

Features:
- New .8mm Ultra SCSI Connector
- Triple Shielding (Unique Design)
- Double Gold 20u" Plated Connectors
- Diagnostic Indicators • Large Ferrite Filters

From: $109

14 & 29 Bay Ultra SCSI Towers

From: $999

14 & 29 Bay - ***The Ultimate Large SCSI Storage Solutions***
Shown with optional Bay Coolers and Dual Redundant Power Supply. Multiple SCSI Channel Support and Modular Designed Expansion.

Gold External Ultra SCSI Cases

- Ultra SCSI Custom Teflon Cable Available
- Custom Enclosures in 1 Day for Raid & Arrays

From: $99

Temperature ALARM!
Automatic Monitor & Control

The Vertical 3.5" Case Kit offers a small transportable package. Ideally suited for moving around, this durable case can take a beating. Universal 35 Watt power supply.

From: $59

The Horizontal 3.5" or 5.25" Case Kit Offers a stackable solution for any desktop need. Shown with Optional Bay Cooler installed.

Open Face and Closed Face Models Available. Optional 50 or 68 Teflon® Cables Available.

Dual Fan & Bracket $29

Bay Cooler Kit keeps those **HOT Ultra SCSI Drives** COLD as ICE!

HOT SWAP Pull Out Bays
Compatible with all 50 pin & 68 pin SCSI Buses up to Fast SCSI 2. From: $79.00

RACK MOUNT *8-Bay* Commercial Grade Quality
Shown with optional Bay Coolers and Dual Redundant Power Supply.

From: $399

OPTIONS:
- Ultra SCSI Cable Kit
- Dual Redundant Power Supply
- Bay Coolers w / Brackets
- Temperature Alarm System
- Slide Out (400lbs rated) Rails

Temperature Alarm Systems

Temperature is the number one cause for drive failure. Keeping the drives monitored can now easily be done. Systems include outputs for emergency additional fans and computer notification.

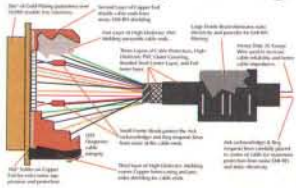
Cool Dual Fan SCSI Cases

Fast SCSI Drives get HOT...but don't worry we have the perfect solution. Our new Dual Fan SCSI Cases keep any drive cool. Temperature is a drives worse enemy.

$69

Granite Cables Are The Best Because They're Engineered Right.

Granite Cables were designed by SCSI Engineers to be the **Best Cables On The Market.** Everything about them means better performance and higher reliability. Our design incorporates an exclusive shield that protects the Acknowledge and Request lines from noise. Large Ferrite beads are installed on all cables to protect them from static and noise. Every cable incorporates a LED indicator that lets you know it is operating properly. We also use more GOLD on every cable. Add to this our impedance matching techniques and you have most of what makes us THE BEST!



NEW! ULTRA 2 SCSI 2X SPEED - 80 MB/s!!!

This is the fastest SCSI available! Twice as fast as Ultra 1 SCSI and without any of its limitations. If you want true horsepower this is the Ultra SCSI system to buy. Completely backwards compatible with Ultra 1 SCSI, Fast SCSI, and SCSI 1& 2!

The key to this new SCSI Standard is the use of Low Voltage Differential Technology. Also known as (LVD) and Ultra 2 SCSI, we can now achieve speeds that far exceed even the fastest computers data thruput capabilities.

Ultra 2 (LVD) - SCSI Repeater / Converter

Now you can take all your SCSI devices and run them any distance you want, (up to 75 feet) while sharing the Ultra 2 SCSI bus. This revolutionary Repeater / Converter will give you, not only long cable distance, but also complete compatibility with the new Ultra 2 standard. There is no need to have two SCSI Adapters taking up precious PCI slots. Two models are available, the internal model that mounts into your enclosure, Raid/Array case, and the external model that can be used anywhere.

$299

Granite D•I•G•I•T•A•L

$399

Custom Teflon® Internal Cables

Teflon® is a registered trademark of DuPont

From: $39

Benefits:
- Less Errors, Ultimate Performance
- Silver Wire Improves Signal Quality

Features:
- Perfect 90 Ohm Impedance • Custom in 1 Day
- Triple Pronged Connector - Gold contacts Silver Wire

68 Pin Internal Cables, custom or stock, from 1 to 15 SCSI devices per cable . We can also make Custom 68 pin and 50 pin Combination Cables that allow you to use narrow drives on a wide cable.

Active Digital SCSI Repeater

From: $139

Benefits:
- Models for all SCSI types
- Fixes SCSI Cable Problems

Features:
- Doubles Cable Length (up to 18')
- Active Termination and Signal Purification
- Ultra Fast Performance for Added Capabilities
- Diagnostic Capabilities • 30u" Gold Contacts

OEM SCSI Repeater

If you integrate SCSI Raids or Arrays and are having problems making it work, the Granite SCSI Repeater will make it work. Designed to fit inside any computer or external case. These repeaters will double the cable length of any scsi bus allowing you to achieve the needed distance to make your system operate. Up to 3 repeater can be used.

SCSI Cable Tester - LED Readout

This Digital SCSI Cable Tester can test all the popular cable styles for opens, shorts, and unreliable operation. Battery powered for easy use anywhere you need it. Three models to choose from:
- **50** pin IDC
- **50** pin Centronics
- **68** pin MicroD

From: $49

The Book of SCSI - An Adventure

$34

Considered "The Bible" of SCSI Books, it includes chapters on SCSI basics thru Advanced SCSI. Written so that all of us can understand it, this is a reference guide that can be used by anyone. Its the best SCSI we have seen.

SCSIPRO Utilities - SCSI Repair

A combination of SCSI Utilities that helps you manage and diagnose SCSI problems. Allows you to set the drive for AV or Data optimization. Does custom block by block copies. Allows you to monitor SCSI operations. For Windows 3xx, 95 and NT

$99

Ultra 2 (LVD) - SCSI Host Adapter

This is the fastest SCSI Host Adapter on the market. Two Times as fast as Ultra SCSI, Ultra 2 SCSI can run up to 80MB/s!

From: $299

This blistering fast speed is accomplished using (LVD) technology. This new technology also allows you to use all the existing peripherals that you currently own and share them with this Ultra Fast Bus.

Cable length has also been a limitation with Ultra SCSI, but with Ultra 2 the cable length is no longer an issue. You can easily connect up to 15 devices on this bus and have room to spare. Also with the use of our Ultra 1 to Ultra 2 repeater/converter you can use all of your existing peripherals and your new LVD peripherals and get up to 4 times the original cable length.

Online Catalog at... www.scsipro.com **The SCSI Solution Company**

3101 Whipple Rd. Union City, CA. 94587 Ph: 510-471-6442 Fax 510-471-6267

Enter HotBYTEs No. 132 at http ://www.byte.com/hotbytes/

Breakthrough

In Keyboard Monitor Switches

Multi Platform & On-Screen Display

SEE US AT:
CeBIT
Hannover, Germany
March 19-25, 1998
Hall 11, C40, B1

BREAKTHROUGH the clutter of multiple keyboards, monitors, and mice with this latest **INNOVATION** from Rose. This switch has every feature you asked for:

- Switches several servers or computers to a single monitor, keyboard, and mouse
- Supports any mix of PC, Apple, Sun, RS 6000, HP 700 series, DEC Alpha, SGI, or other computers from any keyboard or mouse
- Front panel has keypad for easy selection of computers and configuration
- Front panel display shows computers name and other information
- Command to switch can come from your keyboard, front panel, or RS232 port
- Simple to use keystrokes switch computers for fast and easy control
- Built in daisy-chaining to support up to 256 computers
- Flash memory for future upgrade of features
- Easy to use **OverView™** system gives control and status with on-screen graphics
- Many other features!

ROSE ELECTRONICS INVENTED the first keyboard-monitor switch. We have an extensive line of keyboard and video control products for any application.

CALL TODAY FOR FREE CATALOG:

- *Keyboard/Video Control*
- *Print Servers*
- *Data Switches*

800-333-9343

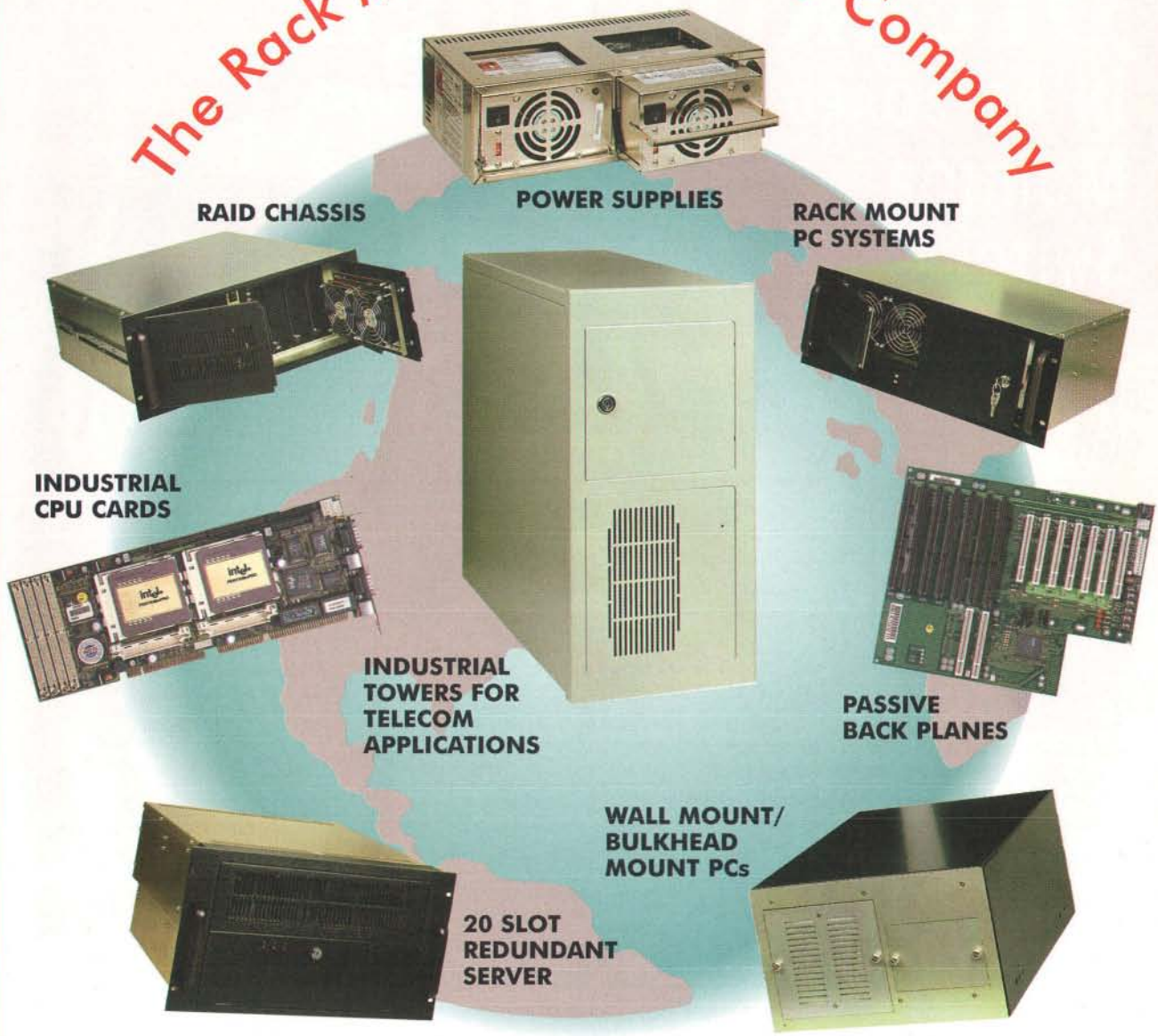
VISIT OUR WEB SITE AT WWW.ROSEL.COM

ROSE ELECTRONICS

10707 STANCLIFF ROAD HOUSTON, TEXAS 77099 TEL 281-933-7673 FAX 281-933-0044

Enter HotBYTEs No. 129 at http ://www.byte.com/hotbytes/

The Rack Mount Computer Company



Global solutions

TRI-MAP INTERNATIONAL

BS EN ISO 9002 Registered (UK)

- Designed and manufactured in house by Tri-MAP International.
- Full design, customisation and production service in the UK and USA.
- Chassis, industrial CPU cards, passive back planes and power supplies.

UK Manufacturing Headquarters
Units 2 & 3, Kingscroft Court, Ridgway, Havant, Hampshire, UK
Tel: 01705 424800 Int: +44 1705 424800
Fax: 01705 424801 Int: +44 1705 424801
email: sales@map.co.uk *Web:www.tri-map.com*
31,000 sq ft production facility

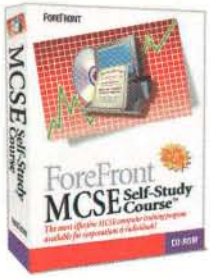
USA Manufacturing Headquarters
4569A Las Positas Road, Livermore, California, CA94550, USA
Tel: 510 447 2030 Int: +1 510 447 2030
Fax: 510 447 4559 Int: +1 510 447 4559
email: trimapintl@earthlink.net Web: www.rackco.com
30,000 sq ft production facility

Enter HotBYTEs No. 131 at http ://www.byte.com/hotbytes/

Get Trained. Get Certified. GET PAID!

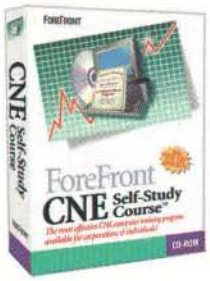
ForeFront offers the fastest and easiest way to prepare you for a career in the Information Technology (IT) industry. From introductory self-study courses to industry certifications like MCSE, ForeFront has the training to meet your needs. Our courses are 100% Computer Based Training (CBT) to give you flexibility unmatched by traditional training methods. Study at your own pace using our step-by-step format, when and where it's convenient for you!

- **Boost Your Income**
- **Enhance Your Credentials**
- **Increase Your Skills and Competence**
- **Study at Your Own Pace**
- **Hands-on Interactive Simulations**
- **No Books, Videos or Classrooms**
- **All on One CD-ROM!**



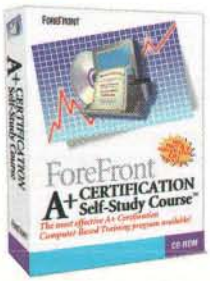
Become MCSE Certified ...FAST!

The ForeFront MCSE Self-Study Course™ ensures the highest rate of information retention so that when you complete your training you'll be fully prepared to pass your MCSE exams. You'll be ready and confident to go into the workplace to effectively plan, implement, maintain and support information systems in a wide range of computing environments, using Windows NT and other Microsoft® Server products.
Call now to get more details!



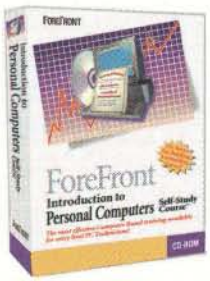
Become CNE Certified ...FAST!

The ForeFront CNE Self-Study Course™ provides fast, effective and convenient training to anyone wishing to become a Certified Novell Engineer, even when hampered by a busy schedule. Our CNE CBT allows you to learn and practice *everything* you'll need for full Novell certification. **Call now for more information!**



Become A+ Certified ...FAST!

Getting A+ Certified will help open the way to further advancement in the corporate world. **The ForeFront A+ Certification Self-Study Course™** is a hands-on self-study course that will give you all the technical material, knowledge and interactive exercises you'll need to pass your exams and excel in today's competitive PC repair marketplace!
Call now to learn more!



New! Introduction to PCs Self-Study Course™

Provides the easiest and most effective way to learn the technical fundamentals necessary for a productive and successful career as a PC Repair Technician. Ideal for individuals new to the IT profession! **Call now for more information!**

Call for Special Discount Pricing Today!

1-800-475-5831

Local U.S: (813) 724-8994 • FAX (813) 726-6922

Ireland: 1800 66 00 11 UK: 0800 279 2009
Europe: (353) 1 670 3177 Fax: (353) 1 670 3211

MasterCard VISA AMERICAN EXPRESS DISCOVER/NOVUS

- **Free Technical Support**
- **Next Day Shipping**
- **Performance Guaranteed**

FORE FRONT™ DIRECT

25400 U.S. Hwy. 19 N., #285
Clearwater, FL 34623

GSA# GS-35F-4628G

Copyright ©1998 ForeFront Direct, Inc. All Rights Reserved. ForeFront MCSE, CNE, A+ Certification and Introduction to Personal computers Self-Study Courses are trademarks of ForeFront Direct, Inc. The ForeFront Logo is a trademark of the ForeFront Group, Inc. All other trademarks are the properties of their respective holders. ForeFront Direct, Inc. is a subsidiary of ForeFront Group, Inc.

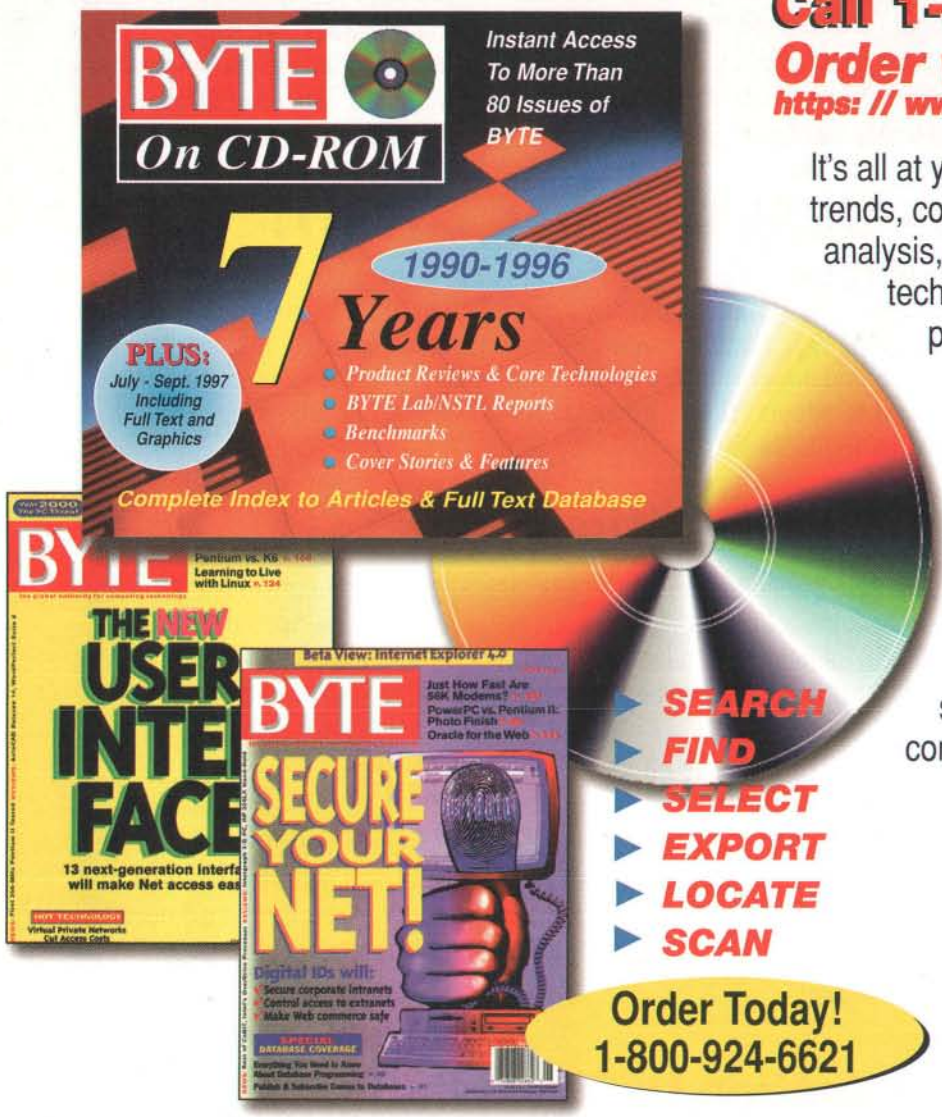
BM

The Definitive Reference Source!

BYTE on CD-ROM

Eight Years of BYTE — 1990 to Present
Plus, Quarterly Updates

Call 1-800-924-6621 or
Order via the Web at
https: // www.byte.com/orders/subcd.htm



It's all at your fingertips — emerging trends, comprehensive world-wide industry analysis, multiplatform coverage of all the technologies, in-depth testing and product evaluations, advice, tips, expert opinions, and much more! It's a deal for anyone who's evaluating the significance of new technologies...doing research...making complex multi platform purchasing decisions...developing the next generation hardware or software products...preparing corporate plans.

Order Today! 1-800-924-6621

It's Comprehensive... Time Saving...and Easy to Use! It's all in BYTE on CD-ROM.

Available for Windows 3.1, NT, Win 95.

Order Now!

Toll-free International Numbers:

Belgium	080071635
Germany	0130826112
U.K.	0800973017
Italy	167876155
France	05916088
Netherlands	060222146
Switzerland	1557257
Denmark	80017728
Sweden	020791136
Other	
Int'l	091-752792
U.S./Canada	1-800-924-6621
FAX	609-426-5434

YES! I want the power and convenience of BYTE on CD-ROM.

❑ **Send me BYTE on CD-ROM *PLUS*!** The currently shipping version, *plus* 3 quarterly updates. 90+ issues for just **$54.95.**
❑ **Send me BYTE on CD-ROM!** Full text from Jan. 1990 through the end of the currently shipping quarter — over 90 issues for only **$39.95.**

Charge my: ❑ **Master Card** ❑ **VISA** ❑ **Amex** ❑ **Check enclosed** (Payable to BYTE magazine, US funds only)

Card # _____ Exp. Date _____ Signature _____

Name _____

Address _____

City _____ State/Province/Country _____ Zip/Postal Code _____

E-mail Address _____

BYTE

Mail to: BYTE on CD-ROM, P.O. BOX 526, Hightstown, NJ 08530 PWRLD

Canadian and U.S. orders, please add $2.95 for shipping and handling, and state tax where applicable. (Canadian orders add appropriate GST). Outside North America, add $5.00 for air mail delivery. Allow 6-8 weeks for delivery.

A Division of The McGraw-Hill Companies

Introducing

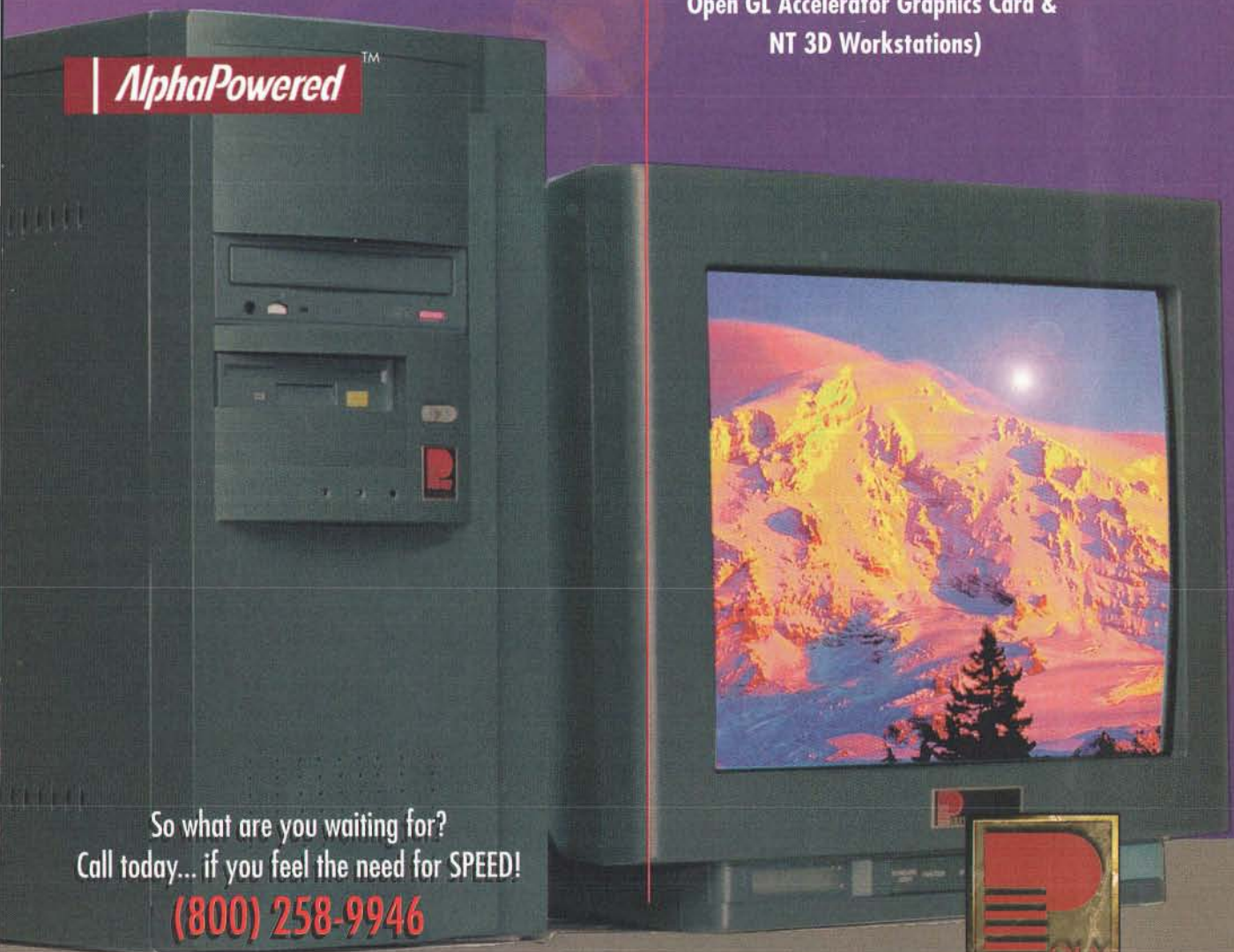
POLYWELL ALPHA GOLD SERIES

How does an Alpha with OpenGL running at 533Mhz... for under $2995! * sound to you?!

CAD/CAM · ANIMATION · VIDEO EDITING · INTERNET/INTRANET · SQL SERVERS

Polywell offers Alpha based systems designed to BLAST through the heaviest, most intense tasks you can throw at them!!

*** (533Mhz Alpha CPU, 2MB Cache with 64MB ECC RAM, 4GB Ultra Fast Hard Drive, Open GL Accelerator Graphics Card & NT 3D Workstations)**



So what are you waiting for?
Call today... if you feel the need for SPEED!

(800) 258-9946

Alphapowered is a trademark of Digital Equipment Corporation

Waranty and Support
5-year in-house labor, 2 year standard parts
24-tech support, optional on-site service
10-year toll free support,
30 day money back guarantee

Enter HotBYTEs No. 128 at http://www.byte.com/hotbytes/

POLYWELL SYSTEMS

Polywell Computers - 1461 San Mateo Avenue - South San Francisco - CA 94080 USA
Tel: (650) 583-7222 Fax: (650) 583-1974 Email: Info@polywell.com Web Site: www.polywell.com

40,000 REASONS TO HOST WITH HIWAY

Serving 40,000 domains, Hiway is the world's most popular web hosting provider.

And with good reason. We deliver the best performance by using the fastest equipment available. We guarantee 99.5% uptime. We offer the most responsive service, including around the clock support in multiple languages. Is it time to choose a web hosting provider? Then choose Hiway for reliability. And for performance. And for 40,000 other reasons. **Order online at www.hway.net** and your site will be hosted today.

Features

- ✓ 3 T3 lines to diverse backbones
- ✓ Silicon Graphics WebFORCE Servers
- ✓ Industrial-strength Cisco routers
- ✓ 99.5% uptime—guaranteed!
- ✓ Full generator backup
- ✓ 40 terabyte tape archive system
- ✓ 24 x 7 network operation center
- ✓ 30 day money-back guarantee
- ✓ 24 x 7 multilingual support
- ✓ Accounts set up within a few hours
- ✓ Domains registered within 24 hours
- ✓ Serving 500 million hits per month

The world leader in FrontPage™ hosting

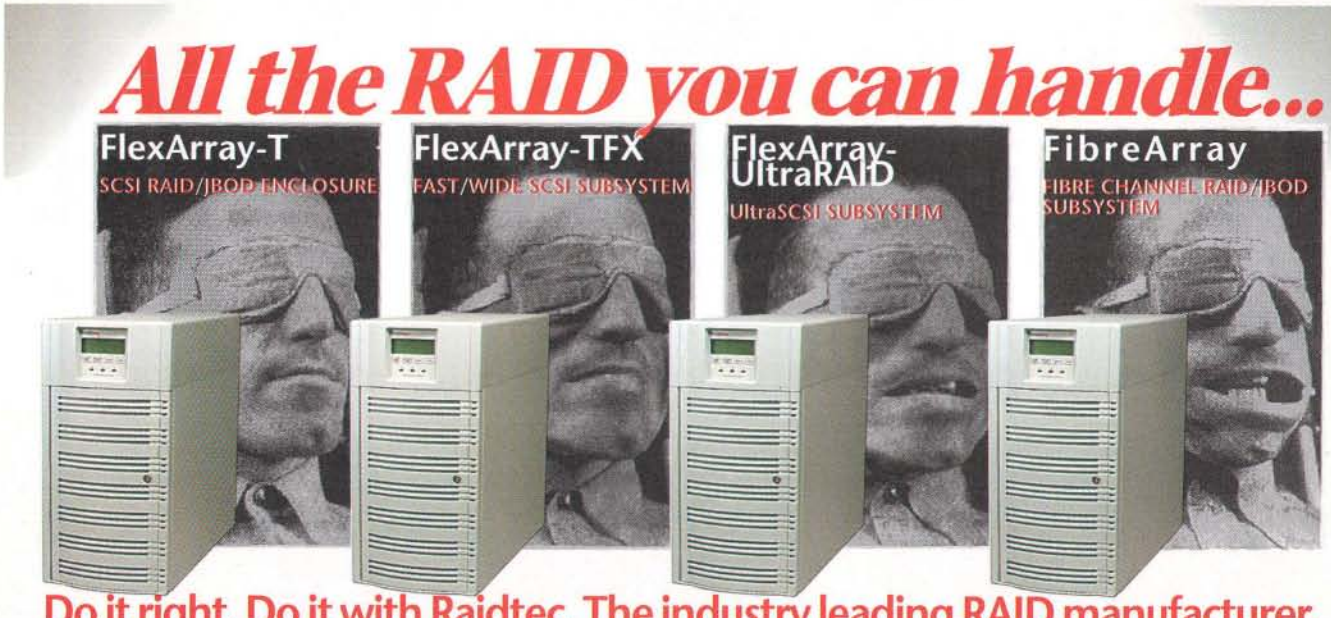
PLANS FROM **$24.95** per month

Reseller Opportunities Available

(800) 339-HWAY
www.hway.net
(561) 989-8574
Career Opportunities Available

Hiway Technologies
THE WORLDWIDE LEADER IN WEB HOSTING

All the RAID you can handle...



Do it right. Do it with Raidtec. The industry leading RAID manufacturer.

- State-of-the-art Fibre Channel, Fast & Ultra SCSI RAID Systems - Up to 200MB/sec
- Tower or 19" Rackmount Configurations - 12 GB to TeraByte Capacities
- Programmable RAID Levels (0,1,3&5)
- PCI & Host Independent RAID controllers
- Hot Swap Drive Bays, Fans & Power Supplies
- RAIDman™ GUI Software for Remote Alarms, Configuration & Monitoring
- LCD Status Display
- Environment Array Manager
- Auto Sensing, Universal N+1 Power Supplies

Raidtec Corporation (USA)
Tel. 770-664-6066
Fax. 770-664-6166
eMail: raidtec@raidtec.com

Raidtec Corporation (Europe)
Tel. 353-21-353440
Fax. 353-21-353799
eMail: raidtec@raidtec.ie

www.raidtec.com

Raidtec CORPORATION

Enter HotBYTEs No. 133 at http://www.byte.com/hotbytes/

CLONE, FORMAT, REPAIR AND TEST ANY DISK DRIVE

STAND ALONE DRIVE DUPE-IT! CLONES ENTIRE DRIVES

Copy entire hard drives with ease. Why spend hours installing and formatting drives when you can do it instantly with Drive Dupe-It! Set up any SCSI or IDE drive with all your original software. Connect blank drives and press start. You'll copy entire drives instantly!

With our combo IDE/SCSI model, you can copy entire hard disk images from IDE to SCSI or vice-versa.

HOT NEW TECHNOLOGY REPAIRS DRIVES

Don't throw those used drives away! Breathe new life into old drives with Dupe-It! Pro. Reassign and eliminate bad SCSI blocks and IDE defects. Put the built-in drive repair system to work for you. Here's how it works: First, a precise analysis system scans the disk surfaces for errors. Defects are then mapped around and effectively "erased". The built-in error correcting system "trains" the drive to permanently avoid defective areas. Your data is stored only on safe areas of the disk. Capacity is reduced by an insignificant amount, and the drive works flawlessly once again.

Get the technology used by major repair shops and modern data recovery centers. Dupe-It! Pro repairs all disk defects caused by normal wear. Drives with excessive mechanical damage may not be repairable.

PRO MODEL INCLUDES FACTORY TEST SYSTEM

Choose the Dupe-It Pro, and you'll also have an entire factory drive test system for under $1000. The Pro model gives you the ability to copy, reformat, repair, translate, and test any hard disk drive. Use the Pro to put any hard drive through its paces. A full factory final test and performance analysis is performed. Complete test and repair reports are sent to any standard printer.

STAND ALONE IDE DRIVE DUPE-IT
P/N IDI ..... $395.

COMBO IDE AND SCSI DUPE-IT WITH TRANSLATOR
P/N SDI2 ..... $795.

PRO MODEL LOADED WITH IDE AND SCSI INTERFACES, TRANSLATOR, DRIVE MECHANIC, AND DRIVE DIAGNOSTIC TEST SOFTWARE WITH PRINTER PORT
P/N SDIPRO ..... $995.

CSC

CORPORATE SYSTEMS CENTER
www.corpsys.com

ORDER FACTORY DIRECT:

408-743-8732

CD DUPE-IT! IS SOLD AND INTENDED FOR BACKUP AND IN-HOUSE DUPLICATION PURPOSES ONLY. COPYRIGHT LAWS MUST BE OBSERVED. CALL FOR RACK MOUNT AND MULTI-DRIVE COPIERS.

COPY ANY CD INSTANTLY!

CD DUPE-IT!

Instantly duplicate master CDs for software distribution. Make spare backup copies of your favorite software on rugged, permanent media. Produce custom discs quickly and economically. No mastering or multimedia experience is required.

ONE BUTTON OPERATION. NO PC NEEDED.

Insert your original disc and press "start". The multimedia processor quickly copies any CD to the internal A/V hard drive. Insert blank discs and make as many copies as you like. You'll produce identical, bit-for-bit duplicates. The system is totally self contained — no computer is needed. Just plug it in and press "start". You'll get perfect copies of any CD.

BUILD YOUR OWN CUSTOM AUDIO DISCS!

You can make your own custom audio discs without a PC! Insert your original CDs, select the tracks you want, and copy them. Then insert a blank CD-R, and you'll have a custom audio disc with just the songs you want.

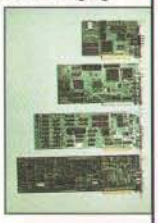
With the included CD mastering software, CD Dupe-It will work overtime. Just attach a SCSI cable to your PC or Mac, and you're ready to design and create your own original CDs.

CD DUPE-IT! ..... $1095.
CASE OF 100 BLANK DISCS (Green/Gold) ..... $159.
CASE OF 100 BLANK DISCS (Gold/Gold) ..... $199.

Video Frame Grabbers

The VFG512-8 is a multi-featured high performance industrial frame grabber.
- Machine vision, internet publishing, robotics, microscopy, medical imaging
- 512 x 512 resolution, 256 grey scale levels, LUT, overlay
- External trigger, EX/IN pixel clock, optional square pixels
- NTSC & PAL video input/output, genlockable, high S/N gain
- Free library of over 100 image processing routines: histograms, convolutions, edge detections, etc.

VFG512-8 (grey scale capture) $395
VIDEO GALA (Color video on your VGA monitor) $495
HRT512-8 (grey scale capture and video output, research grade s/n ratio) $995

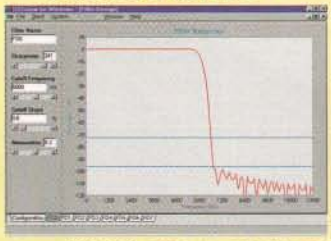


High Res Technologies, Inc.
Tech Support: 416-497-6493
Sales: 800-288-2207 Fax: 416-497-1636
e-mail: hrt@planeteer.com

HotBytes No. 85

DIGITAL SIGNAL CONDITIONING

from MICROSTAR LABORATORIES™



- 16-bit data acquisition
- Programmable filtering
- Wide cut-off range
- 4MB onboard buffer
- 8 simultaneous inputs
- DASY*Lab*, LabVIEW
- HP VEE, etc
- DLL for custom code

888-678-2752 ◇ 425-453-2345 ◇ 425-453-3199 fax
888-MSTARLABS ◇ info@mstarlabs.com ◇ www.mstarlabs.com

THE NEW BL1700
Configurations from
$199
QUANTITY 100

CONTROL PRACTICALLY ANYTHING

WITH THE NEW BL1700

C-programmable controller. Ideal for machine control, embedded control, and OEM applications. Digital and analog inputs interface with a variety of sensors. Perform real-time multitasking and floating point math. Allows controller networking via RS-232/RS-485.

- 32 digital I/O expands to 288
- 10 A/D inputs
- 4 full-duplex serial ports
- LCD and expansion bus ports
- Flash EPROM to 512k

Z-World's Dynamic C® software development system includes an integrated editor, compiler, and debugger. Your design effort is simplified and your development time is fast.

To order a development kit or receive a FREE catalog, call:
1.888.362.3387
(USA and Canada)

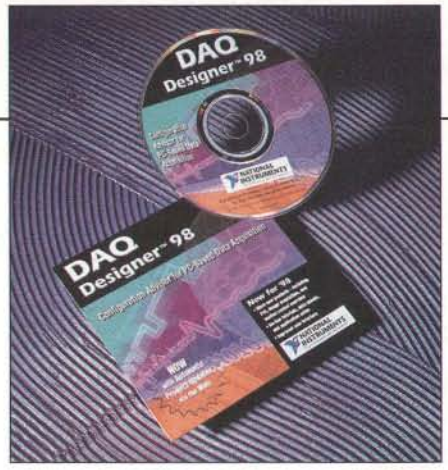
Visit our web site at:
http:/www.zworld.com

ZWORLD

2900 Spafford Street
Davis, CA 95616 USA
Ph: + 530.757.3737
Fax: + 530.753.5141

INNOVATION IN CONTROL TECHNOLOGY

HotBytes No. 86



The '98 How-To Guide for Data Acquisition

DAQDesigner 98 takes you step-by-step through your data acquisition application, recommending hardware and software (including PC DAQ, signal conditioning, image acquisition, motion control, and PC instruments) that best fit your specific needs. The CD-ROM includes on-line tutorials, data sheets, app notes, and automatic product updates via the web.

National Instruments
6504 Bridge Point Parkway, Austin, Texas 78730
(512) 794-0100 (800) 433-3488 (U.S. and Canada)
Fax: (512) 794-8411
E-mail: Info@natinst.com www.natinst.com

HotBytes No. 93

See us at CeBIT'98, Hall 5, Stand F36, Booth B12

The Communicator

Run DOS from ROM
Stand alone 386 CPU

KS-67 CPU with AMD 386
Up to 6MB Memory, FLASH
7 standard Serial ports (RS485)
Ethernet (NE2000)
PCMCIA, 2 Par., AT Bus

$249 +q100

KILA DOS-IN-ROM

www.kila.com
303-444-7737 Fax 303-786-9983 sales@kila.com

Let your true colors shine through

Advertise your product in the
BYTE HARDWARE/SOFTWARE SHOWCASE
the popular, affordable, 4-color advertising section!
For more information call your BYTE sales representative (see listing, page 151) or fax 603-924-2683

BYTE Magazine. It's not for everyone.

Enter HotBytes number at www.byte.com/hotbytes/

Data Acquisition • Desktops

Why have the new **LaserLite™, DuraTrax™,** and **LaserLite *Pro*** received such outstanding reviews?

Because **metal cases** provide impressive strength and durability! You get **over 100,000 scans** from one set of batteries! And, you get **easy-to-use** Windows™ software to build your application!

Best of all—LaserLite, DuraTrax, and LaserLite *Pro* are uniquely affordable!

Videx

Call for your free information packet today. CE

1105 N.E. Circle Blvd., Corvallis, OR 97330
541-758-0521 • Fax 541-752-5285 • http://www.videx.com

GCO834

HotBytes No. 94

Industrial Computers • Multimedia/CD-ROM

RACK MOUNT PC PRODUCTS

ENCLOSURES
- Integrated monitors
- 8 and 14 slot models

MONITORS
- 9" to 17" CRTs
- Monitor enclosures

KEYBOARDS
- Keyboard drawers
- 1 Unit high, 101 keys

SINGLE BOARD COMPUTERS
- Pentium and Pentium Pro SBCs
- MMX Processor Support
- Onboard video and SCSI models
- 8 and 14 slot ISA/PCI backplanes

PRINTERS
- Rack Mount color inkjet printer
- Easy paper & controls access
- HP 600 series inkjet printer enclosure available

RACK MOUNT TFT LCD DISPLAYS
- 12.1" Active Matrix color TFT display
- Drawer, Panel, & 1 rack unit models
- Equivalent viewing of a 14" CRT
- 800x600 resolution, 262K colors

RECORTEC, INC.
1290 Lawrence Station Road
Sunnyvale, California 94089-2220
Ph: 408-734-1290 Fax: 408-734-2140
email: info@recortec.com

Call for our Rack Mount PC Product catalog
1-888-RECORTEC
http://www.recortec.com

Pentium is a registered trademark of Intel Corp.

HotBytes No. 98

Industrial Rackmount Computers

INDUSTRIAL PC SYSTEMS SOLUTION:
- Single Board Computers 486 ~ Pentium Pro
- Passive Backplane 3-slot ~ 20-slot
- Wall Mount/19" Rackmount Chassis
- 4/8/16 Ports Switch Box (PC/KB/Mouse)
- AC PS 90 ~ 260V, DC PS +12V/+24V/-48V

ACI SYSTEMS
Western Region: 1-800-983-1177 Fax: 1-650-428-0866
Eastern Region: 1-800-886-2243 Fax: 1-617-938-8037

HotBytes No. 87

Don't get boxed in!

Sliger DESIGNS

VI Vertical Integration is the answer!

Call us and find out why!

Engineering • Design • Fabrication
- Industrial PC Enclosures
- Tower PC Enclosures
- Rackmount PC Enclosures
- Rack Systems
- Rackmount Accessories
- Rackmount Drive Enclosures
- Redundant N+1 Load Sharing Power Systems
- Industrial PS2/ATX Power Supplies

Phone: 1 800 255 0267 FAX: 1 702 356 6361
Email: info@sliger.com Internet: http://www.sliger.com
Postal: 150 E. Greg Street #105 Sparks, Nevada 89431

HotBytes No. 99

Pentium® II & Sound SBC

Full Line CPU Cards: 386SX~ Pentium® Pro

For Intel Pentium®II 233~333MHz CPU.
Creative Sound Blaster. Ultra DMA/33 IDE.
DiskOnChip® Flash Disk. E²Key™ Function.
PICMG Standard Complied.

ICP ACQUIRE INC.
453 Ravendale Drive, #H Mountain View, CA 94043
TEL: 650-967-7168 FAX: 650-967-5492 www.icpacquire.com.tw

HotBytes No. 88

NOW THAT YOU'RE MAKING YOUR OWN CDs...

HOW DO YOU LABEL THE DAMN THINGS?

• DESIGN • PRINT
• APPLY • PACKAGE

PRODUCE PROFESSIONAL-LOOKING CD LABELS & JEWEL CASE INSERTS FOR $79.95 PRO-PAK

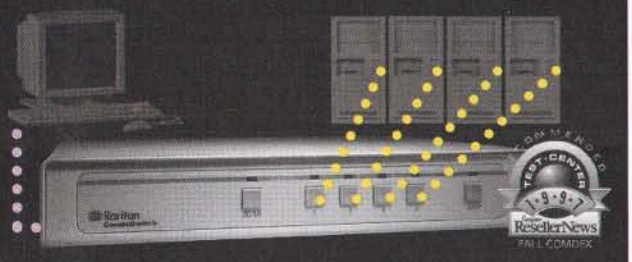
Mastercard • AMEX • VISA www.neato.com

NEATO LLC
USA: 250 Dodge Ave • East Haven, CT 06512
203-466-5170 • Fax 203-466-5178
800-984-9800
Europe: +44 (0)990 561571
Fax +44 (0)181 932 0480

HotBytes No. 89

Enter HotBytes number at www.byte.com/hotbytes/

Control Two to Eight PCs From One Keyboard, Monitor and Mouse



CompuSwitch ™

- All PC brands and operating systems
- Flawless PC booting and operation
- Mix PCs with PS/2 and serial mouse ports
- High-resolution video
- Tangle-proof PC cables

2-Channel $385
4-Channel $595
8-Channel $895

Call Today! 800-724-8090 x17

PC 800-525-4727 | 800-642-8816 | GLOBAL 800-440-4832 | 800-547-5444 | Data Comm Warehouse 800-328-2261

Raritan
Rock-solid reliability for computer access and control

Raritan Computer, Inc.
400 Cottontail Lane
Somerset, New Jersey
08873

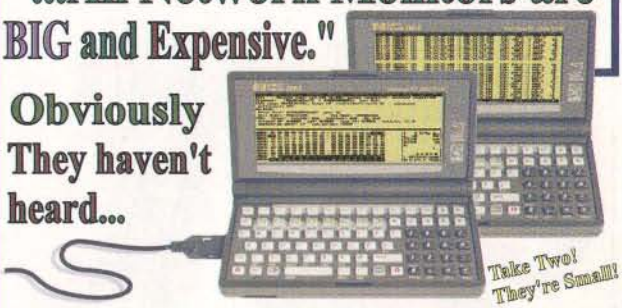
E-mail: sales@raritan.com
http://www.raritan.com
Fax: 732-764-8887
Tel: 732-764-8886

RESELLER INQUIRIES INVITED FULL YEAR WARRANTY

HotBytes No. 95

WHO SAYS??
"...All Network Monitors are BIG and Expensive."

Obviously They haven't heard...



Take Two! They're Small!

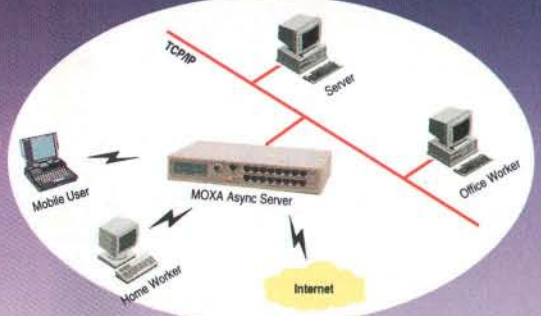
POCKETWatch
Palmtop Protocol Analyzer

Puts the Power of
LANWatch®
in the Palm of your Hand
for under $1,500!!!

PRECISION Guesswork, Inc.
Five Central Street, Topsfield, MA 01983
(508) 887-6570 (phone) http://www.guesswork.com
(508) 887-6552 (fax) Email: info@guesswork.com
*Hewlett Packard is a trademark of the Hewlett Packard Company.

HotBytes No. 97

Think Remote Access Solution Think MOXA



Remote Access environment allows remote users with access to corporate LAN resource or local users with connections to remote workgroups or Internet. MOXA Terminal Server and Multiport serial board provide you with the best and alternative solutions.

MOXA C320 Turbo Multiport Board

- High speed serial ports -- 460.8K bps
- Expandability -- 8 to 32 ports
- Drivers for all popular O.S.
- API-232 Library for Win32 SDK

MOXA CN2100 Async/Terminal Server

- High speed serial ports -- 921.6K bps
- Speedy configuration setup -- in 5 minutes
- Easy software upgrade -- Flash ROM
- User Authentication and accounting -- RADIUS

See MOXA at CeBIT'98 – Hannover, Germany, Booth G64(7) Hall 11, March 19-25 1998

MOXA® Moxa Technologies

www.moxa.com
524 Weddell Drive, Suite 1, Sunnyvale, CA 94089
Tel : (408) 734-2224 Fax: (408) 734-4442
E-mail: info_byte@moxa.com

HotBytes No. 96

386EX Embedded Controller with DOS Complete, Ready-to-Go No Hidden Costs

FlashLite 386 EX NEW!

- 386EX / 25 MHz
- Up to 512K SRAM/flash
- Socket to add 512K Flash/RAM/EPROM
- 2 Serial Ports
- 24 Parallel I/O Lines
- Watchdog Timer
- 3 Counter/Timers
- 3 free interrupt lines
- Battery-backed RTC

BORLAND C $99 includes full source code debugging with C++ Remote Debugger

- Includes DOS, utilities, flash file support
- 32-bit processor runs 386 protected mode
- Complete COM1/COM2 PC compatibility
- Use Borland C or QuickBasic

QTY 100 **$197**
$239 QTY 1
includes 128K RAM 512K flash & DOS

JK microsystems
Cost effective controllers for industry
+510-236-1151
+510-236-2999 fax
www.jkmicro.com

HotBytes No. 91

A104™ Low cost PC/104 Controller. Easy to program in Borland C/C++. NEW!

Prices Start at $169 Qty 1 • $69 OEM

- 3.8" x 3.6" 20/40MHz Am188ES, EE, SRAM, ROM/FLASH
- 3 RS232/485s, Networprk, 3 timers, PWM, Watchdog
- 60+ I/Os, RTC, LCD, PCMCIA, PC/104, Solenoid Drivers
- 5 ch. 24-bit ADC, 11 ch. 12-bit ADC, 4 ch. 12-bit DAC

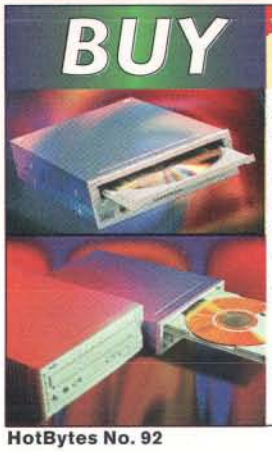
Low Cost C/C++ Development Kits for 20+ Low Cost 16-bit Controllers with ADC, DAC, solenoid drivers, relays, PC-104, PCMCIA, LCD, DSP motion control, 10 UARTs, 100 I/Os. Custom board design. Save time and money!

TERN INC.
1724 Picasso Ave. Ste A
Davis, CA 95616, USA
Tel: 530-758-0180
Fax: 530-758-0181
tern@netcom.com
http://www.tern.com

HotBytes No. 90

Enter HotBytes number at www.byte.com/hotbytes/

Storage



BUY your STATE OF THE ART CD-Recorders

from CONSAN—the best high-end integrator for all your mass storage needs.

CDR • DISK • TAPE • OPTICAL • RAID

NOW AVAILABLE from Yamaha

4X2X6—first ever IDE INTERFACE in a CDRW.

4X RECORD 2X WRITE 6X READ

This is the multi-function drive you've been waiting for. Call TODAY for aggressive pricing!

1-800-221-6732

CONSAN

A GATES/ARROW Company

18750 LAKE DRIVE EAST
CHANHASSEN, MN 55317
TEL:612-949-0053
FAX:612-949-0453

© 1997 Consan, Inc.

HotBytes No. 92

A Message to Our Subscribers

From time to time we make the BYTE subscriber list available to other companies whose products or services would be of interest to our readers. We take great care to screen these companies, choosing only those who are reputable. Furthermore, subscriber names are made available for direct mail purposes only; telemarketing calls are strictly prohibited.

Many BYTE subscribers appreciate this carefully managed program, and look forward to receiving information of interest to them via the mail. While we believe this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive promotional literature. Should you wish to restrict the use of your name, please send your request (including your magazine mailing label, name, address, and subscription account number) to:

BYTE Magazine
Subscriber Services
PO Box 555
Hightstown, NJ 08520

BYTE Magazine.
It's not for everyone.

Internet Services

Headache Free Web Hosting, 80 MB, $19.95 a Month

www.yourcompany.com and unlimited e-mail

DID YOU KNOW?
YOUR OWN WEB SITE IS ONLY $19.95 A MONTH

1-800-656-7581
(404-586-9999)
http://order.interland.net

Web Hosting with InterLand is Different

There are over 40,000,000 people on the Internet today that can order your goods or services. If you make one sale or lead form your website, it probably pays for itself for a year or two. It's easy. We'll help you get started.
Isn't it time to find out more?

Basic Plan includes FrontPage support, Secure Server, Full CGI access, 80 MB website storage and more.

InterLand, Inc.

30 DAY MONEYBACK GUARANTEE

http://www.interland.net Fax: 404-586-0001

HotBytes No. 100

Something Missing?

Complete your BYTE collection by ordering Back Issues today!

	1993	1994	1995	1996	1997	1998
January	☐	☐	☐	☐	☐	☐
February	☐	☐	☐	☐	☐	☐
March	☐		☐	☐	☐	
April	☐	☐	☐	☐	☐	
May	☐	☐	☐	☐	☐	
June	☐	☐	☐	☐	☐	
July	☐	☐	☐	☐	☐	
August	☐	☐	☐	☐	☐	
September	☐	☐	☐	☐	☐	
October	☐	☐	☐	☐	☐	
November	☐	☐	☐	☐	☐	
December	☐	☐	☐	☐	☐	
Special Issues	☐ Windows Portability	☐ Windows '93 ☐ B Guide Summer '93 ☐ B Guide Fall '93				

Special Issues U.S. Delivery $3.00, Foreign Delivery $4.00 · 1990 thru 1998 U.S. Delivery $6.50, Foreign Delivery $8.50, Canada & Mexico $7.00 · All issues prior to 1990 U.S. Delivery $3.00, Foreign Delivery $4.00. (Call for availability) These prices include: postage (US), surface mail (foreign). · All checks must be in U.S. funds and drawn on a U.S. bank. Please indicate which issues you would like by checking (✓) the boxes. Send requests with payment to: Back Issues, One Phoenix Mill Lane, Peterborough, N.H. 03458, (603) 924-9281

BYTE

☐ Check enclosed ☐ Charge:
☐ VISA ☐ MasterCard ☐ American Express
Card # ☐☐☐☐-☐☐☐☐-☐☐☐☐-☐☐☐☐
Exp. Date ☐☐-☐☐
Name
Signature

First Name
Last Name
Address
Address
City
State Zip ☐☐☐☐☐

A Division of The McGraw-Hill Companies

Enter HotBytes number at www.byte.com/hotbytes/

THE BUYER'S MART

A DIRECTORY OF PRODUCTS AND SERVICES

THE BUYER'S MART is a unique classified section organized by product category to help readers locate suppliers. Ads may have inquiry numbers to aid readers requesting information from advertisers.
AD FORMAT: Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers should furnish typewritten copy. **2"x1 1/16"** ad can include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. **2"x2 5/8"** ad has more space for descriptive text (850 characters is the maximum recommended).
DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 15. Send your copy and payment to:
THE BUYER'S MART,
BYTE magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458.
For more information please call Vivian Bernier at 603-924-9281 or FAX: 603-924-2683.

RATES (January 1998)

1x rate	3x rate	6x rate	12x rate	24x rate
		2"x1 1/16"		
$960	$945	$930	$910	$815
		2"x2 5/8"		
$1,920	$1,890	$1,860	$1,825	$1,630

••••••••COLOR – Add $125 •••••••••

BAR CODE

Bar Code Headquarters

- Complete Bar Code Readers from **$299**
- Portable Bar Code Readers from **$759**
- Laser Gun Readers from **$549**
- Cordless Scanners from **$595**
- Two way RF Terminal - **$1095**
- Bar Code Labeling Software for Windows - **$295** DOS Version - **$279**
- Bar Code Fonts for Windows/Mac - **$199**
- **Direct from Manufacturer**

Worthington Data Solutions
800-345-4220
Phone: 408-458-9938 • Fax: 408-458-9964
In UK call 0800 393 213
In France call 0800 90 65 47
In Germany call 0130 8150 84
Rest of Europe call 353 1 6614 566
Website: www.barcodehq.com

Bar Code Products

- *Bar Code Reader Packages*
- *Laser Scanner Packages*
- *Portable Bar Code Readers*
- *Bar Code Printing Software*
- *Bar Code Labeling Software*
- *Lasers, CCDs, Wands & Printers*
- *Complete Line of Accessories*

30-Day Money Back Guarantee
Lifetime Toll-Free Support
15 Years In Business
Most Items Shipped Same Day

American Microsystems, Ltd.
2190 Regal Parkway • Euless, Texas 76040
800-648-4452
WWW.AMLTD.com
Phone 817-571-9015 • Fax 817-685-6232
2190 Regal Parkway • Euless, Texas 76040

HotBYTEs No. 382

CAD/CAM

CONTOURING MOTION CONTROL
FROM A PRINTER PORT!
Indexer LPT™ software
VERSION 3 **$249** VISA/MC

- Controls up to six step motors simultaneously.
- Linear and Circular Interpolation.
- New features to accommodate machine control.
- Easy-to-use device driver. Super Manual.
- CAD-CAM interface available.

Ability Systems
http://www.abilitysystems.com
Corporation, 1422 Arnold Ave.
Roslyn, PA 19001 (215) 657-4338
FAX: (215) 657-7815

HotBYTEs No. 381

DATA RECOVERY

We Can Save It!
All Platforms - All Storage Devices
Proprietary techniques so advanced we rescue data others simply abandon.
DRIVESAVERS
Restoring data since 1985
1-800-440-1904
415-883-4232

HotBYTEs No. 391

The Leader in Data Recovery

- Expertise in virtually every operating system & media storage device.
- Emergency services with calls answered 24 hours a day. Call for a FREE consultation!

ONTRACK DATA RECOVERY
Mpls • LA • San Jose • DC • London • Tokyo • Stuttgart
1-800-872-2599 • www.ontrack.com

HotBYTEs No. 385

Don't pay thousands of Dollars! Download our
DO-IT-YOURSELF
Data Recovery Software
TIRAMISU.
We support DOS, WINDOWS, NOVELL and NTFS file systems
http://www.recovery.de
Email: data_recovery@compuserve.com
The Virtual Data Recovery Company

HotBYTEs No. 394

EDUCATION

AMERICAN INSTITUTE FOR COMPUTER SCIENCES

- Earn B.S. and M.S. in Computer Science
- DISTANCE EDUCATION
- Object oriented B.S. program
- New courses in Java, Networking, HTML, MIS and more
- Approved by more than 275 companies
- Follows ACM/IEEE guidelines
- Thousands of students throughout U.S.

For a free catalog 1-800-767-AICS or
http://www.aics.edu
Accredited Member: World Association of Universities and Colleges

GEOGRAPHICAL SYSTEMS

A R E A ?
CIRCUMFERENCE?
L E N G T H ?
Measuring any object in plan photo, graphic - made easy.
SuperPlanimeter™
www.Aristo.de

HotBYTEs No. 389

GRAPHICS

GraphiC from Scientific Endeavors
Stunning scientific graphics
http://www.sciend.com
C, Fortran, VB libraries

HotBYTEs No. 397

HARDWARE

"THE STORAGE DEPOT"
• AT/ATX File Server Chassis •
• Rackmount Chassis •
• SCSI/RAID Enclosure •
• CD-ROM Tower •
• DataCarrier (Removable HDD Rack) •
1-888-33COMIX
http://www.33COMIX.com
Comix Computers Inc. Chino, CA 91710

HotBYTEs No. 398

HEWLETT-PACKARD
Buy — Sell — Trade
LaserJet Colorpro DeskJet
Draftpro Ruggedwriter Draft/Master
Eletrostatic Plotters DesignJet
We specialize in Demo & Refurbished Equipment
HP 9000 Workstations and Vectras also Available
Ted Dasher & Associates
PO Box 131269 Birmingham, AL 35213-6269
Phone: (205) 263-4747 Fax: (205) 263-1108
(800) 638-4833 E-mail: sales@dasher.com

HotBYTEs No. 387

INPUT DEVICES

W O R L D ' S
M I G H T I E S T
M O U S E
GeoMouse®
www.Aristo.de

HotBYTEs No. 388

Enter HotBYTEs number at www.byte.com/hotbytes/

INTERNET

NETDBC
windows nt – linux

- reporting tool from www
- connect your database to www
- dynamic and static variables
- wizard configuration

www.fastflow.com info@fastflow.com
demo and downloads available on-site

HotBYTEs No. 399

INTERNET PRESENCE

Virtual Web Hosting • 3-T3 Connections!

www.YourName.com

$19.97/mo.

(800) 808-9241 / FREE "web" Page

http://PICK.NET RESELLERS Welcome

HotBYTEs No. 393

PROGRAMMERS' TOOLS

High-Speed xBASE Engine...

For C, C++, VB, Delphi and Java programmers. Get multi-user compatibility with FoxPro, Clipper and dBASE files. CodeBase is portable between DOS, Windows, UNIX, Mac and OS/2! Includes unlimited client/server, ActiveX controls & visual report writer!

FREE 30 day test drive!

Call **Sequiter Software Inc.** for details or visit us on the web at www.sequiter.com

Phone 403 437-2410 FAX 403 436-2999

HotBYTEs No. 386

SECURITY

THE ULTIMATE SOFTWARE SECURITY

- STOPCOPY family – UNCOPIABLE copy protection
- STOPVIEW software encryption
- NETLIMIT network license metering
- DOS, Windows (3.X, 95, NT), Mac, OS/2, support
- Machine Tie, Internet Protection, CD-ROM Protection, Serialization, Date & Execution Limitation, Registration, Remote Authentication, Concurrent User Limitation
- Our products destroy ALL of our competition

BBI Computer Systems, Inc.

14105 Heritage Lane, Silver Spring, MD 20906

800/TRY-ABBI • 800/879-2224 • 301/871-1094 • FAX: 301/460-7545

E-mail: bbi@bbics.com • Web: http://www.bbics.com

HotBYTEs No. 383

CRYPKEY SOFTWARE LICENSING SYSTEM

"Software Protection with NO hardware lock and NO disk key"

CrypKey is software copy protection that is:

- completely secure from any disk copy program
- perfect for CD-ROM or INTERNET distribution!
- cost effective, user friendly, and 100% guaranteed to satisfy!

CrypKey can increase your software sales:

- upsell options and levels of your software
- lease or demo your software by runs or time
- enable or upgrade your customers instantly by phone, fax or E-mail!

New! unique Ready-To-Try feature upon install allows 1 trial period only per customer. New! unique Add-On feature - add more options, levels, runs or time to existing licenses. New! CrypKey Instant–protects in just 5 minutes with no source code changes.

CrypKey is completely compatible with MS-DOS, MS-Windows 3.x, Win32s, Win95, Win95B/FAT-32, Win NT, and manages network licenses on all Novell and Microsoft operating system based networks.

CrypKey Instant is Ready-To-Try.
FREE for 30 days on our web site:

http://www.kenonic.com/crypkey.htm

Kenonic Controls Ltd. Calgary,Canada

(403) 258-6200 • fax: (403) 258-6201

INTERNET: crypkey@kenonic.com

HotBYTEs No. 390

SECURITY

VT Protect

SECURE SOFTWARE LICENSING FOR PIRACY PREVENTION!

Incorporates a unique "adaptive" fingerprint technology that provides security which is second to none in the industry!

Single tool allows administration of multiple products on Windows and UNIX platforms with full integration measured in hours, not days!

Supports customizeable licensing security and support for multi-channel distribution and selling strategies.

An individual, node locked password generated with **VT Protect Administrator** converts trialware to a full single user product, cutting sales time and reducing licensing headaches.

Download VT Protect Today!

WWW.VTPROTECT.COM

(888) 842-8323 / (508) 647-0464

HotBYTEs No. 396

SIMULATION SOFTWARE

Analog/Digital Simulation!!

- Windows, NT, DOS
- Power Mac, Macintosh
- IsSpice4 Real Time SPICE
- Mixed Mode Simulation
- Schematic Entry
- New AHDL Modeling Kit!!
- Model Libraries, RF, Power
- More Than 5000 parts
- Waveform Analysis
- Full SPICE programs starting at $95. Complete systems, $595-$2595

P.O. Box 710 San Pedro, CA 90733-0710

(310)833-0710, FAX (310)833-9658 **intusoft**

Call for your Free Demo and information kit.

HotBYTEs No. 384

TRANSLATION SOFTWARE

Word Translator for Windows

- **Hot-key translation of words, phrases & documents** from within your word-processor or DTP program;
- **Huge range of languages** including East & West European, Scandinavian, Latin American & Slavic;
- **User-defined dictionary** - add your own entries;
- **Prices start at only US$60** - call, fax or email for details!

CREATIVE TECHNOLOGY (ctsales@net-shopper.co.uk)

Europe: Tel +44 1889 567160 • Fax +44 1889 563548

US: Tel 303 329 8716 • Fax 303 388 1521

http://www.net-shopper.co.uk/trans

HotBYTEs No. 395

YOUR AD HERE

Add Color Impact to Your Ad

in ***The Buyer's Mart.***

For rates and details to start or upgrade your advertising,

call Vivian Bernier today at

603-924-9281

Fax: 603-924-2683

A Message to Our Subscribers

From time to time we make the BYTE subscriber list available to other companies whose products or services would be of interest to our readers. We take great care to screen these companies, choosing only those who are reputable. Furthermore, subscriber names are made available for direct mail purposes only; telemarketing calls are strictly prohibited.

Many BYTE subscribers appreciate this carefully managed program, and look forward to receiving information of interest to them via the mail. While we believe this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive promotional literature. Should you wish to restrict the use of your name, please send your request (including your magazine mailing label, name, address, and subscription account number) to:

BYTE Magazine
Subscriber Services
PO Box 555
Hightstown, NJ 08520

BYTE Magazine.
It's not for everyone.

ADVERTISER CONTACT INFORMATION

To order products or request free information, call advertisers directly or use HotBYTES.
Let them know you saw it in BYTE!

FREE Product Information Service:
www.byte.com/hotbytes/

HOTBYTES NO.		PAGE NO.	PHONE NO.
	A		
87	ACI SYSTEMS	145	800-983-1177
126	ACME PORTABLE MACHINES INC	31	626-814-0516
*	ADAPTEC	82-83	800-804-8886 ext9486
*	ADAPTEC	84-85	800-804-8886 ext9486
159	ALADDIN KNOWLEDGE SYSTEMS GERMANY (IS)	40IS 23	+49-89-894221-0
101	ALADDIN KNOWLEDGE SYSTEMS LTD (IS)	16	212-564-5678
101	ALADDIN KNOWLEDGE SYSTEMS LTD (N.A.)	16	800-223-4277
157	ALADDIN KNOWLEDGE SYSTEMS LTD (IS)	40IS 24	+972-3-636-2222
*	ALPHA POWERED (N.A.)	8-9	888-ALPHA-45
117	ARTECON	33	800-USA ARTE
	B		
*	BYTE CARD DECK (RAS)	104P	603-924-2596
*	BYTE CEBIT '97 (IS)	69	+49-69-5801-123
*	BYTE CEBIT '97 (N.A.)	96NA 1	+49-69-5801-123
*	BYTE GERMANY (IS)	51	+49-89-456-16123
*	BYTE INTERNATIONAL PARTNERS (IS)	36-37	
*	BYTE JOB NET (IS)	104	800-632-7946
*	BYTE MOVING? (IS)	40IS 20	
*	BYTE ON CD ROM (IS)	77	+353-091-752793
*	BYTE ON CD ROM	140	800-924-6621
*	BYTE SUB MESSAGE	149	
	C		
118	CETRA	99	+886-2-2725-1111
102	COMP USA (N.A.)	36-37	800-COMPUSA
143	COMPEX INC (IS)	40IS 5	714-630-7302
*	COMPUTER ASSOCIATES	2-3	888-864-2368
*	COMPUTER ASSOCIATES	95	888-864-2368
103	COMPUTER DISCOUNT WAREHOUSE	89	800-959-4239
92	CONSAN INC	147	800-221-6732
130	CORPORATE SYSTEMS CENTER/CSC	143	408-743-8732
*	COSMO SOFTWARE	103	888-91-COSMO ext282
122	CTL	35	503-646-3733 ext18
135	CUBIX CORPORATION (RAS)	104D	800-953-0147
104	CYBEX COMPUTER PRODUCTS CORP	57	205-430-4000
	D		
*	DECUS	111	800-332-8755
*	DELL COMPUTER CORP (N.A.)	CV-CVIII	800-847-4062
*	DELL COMPUTER CORP (F1000) (N.A.)	CV-CVIII	800-926-9890
*	DELL COMPUTER CORP (N.A.)	77	800-247-2063
*	DELL COMPUTER CORP (N.A.)	96NA 5	800-392-3355
115	DISTINCT CORPORATION	20	408-366-8933
116	DISTINCT CORPORATION	20	408-366-8933
154	DISTIWORLD (IS)	40IS 20	+41-91-649-4631**
144	DISTRIBUTED PROCESSING TECH (IS)	40IS 16	407-830-5522
136	DISTRIBUTED PROCESSING TECH (RAS)	104B	407-830-5522
	E		
150	E-TECH (IS)	11	+886-35-777751**
145	EUTRON (IS)	CV	+39 35 697001
142	EVEREX (RAS)	104M	800-EVEREX-1
105	FAIRCOM CORPORATION	131	573-445-6833
*	FOREFRONT DIRECT INC	139	800-475-5831
	G		
*	GATEWAY 2000	22-23	888-888-0260
132	GRANITE DIGITAL	136	510-471-6442
146	GREY MATTER LTD (IS)	40IS 2	+44-(0)1364-654200**
114	GRIFFIN TECHNOLOGIES (U.S.)	78	800-986-6578
	H		
85	HIGH RES TECHNOLOGIES INC	144	416-497-6493
134	HIWAY TECHNOLOGIES	142	800-339-HWAY
*	HOT BYTES	133	http://www.byte.com/hotbytes/
	I		
*	IBM (N.A.)	15	800 IBM 7255 ext4619
88	ICP ACQUIRE	145	650-967-7168
125	IDT WINCHIP C6 (IS)	51	1-800-WINCHIP
121	INFORMATION BUILDERS (N.A.)	96NA 7	800-969-INFO
100	INTERLAND	147	404-586-9999
141	INTRASERVER TECHNOLOGY (RAS)	104I	888-429-0425
	J		
91	JK MICROSYSTEMS	146	510-236-1151
	K		
*	KILA	144	303-444-7737
137	KINGSTON (RAS)	104E	888-251-9059
156	KYE SYSTEM CORP (IS)	15	+886-2-995-6645
	L		
140	LEOPTICS INC (RAS)	104J	+886-2-218-9068
	M		
*	MCGRAW-HILL COMPUTER BOOK CLUB (N.A.)	104A-B	614-759-3666
*	MCGRAW-HILL COMPUTER BOOK CLUB	105	614-759-3666
*	MCGRAW-HILL NRI (N.A.)	40A-B	800-321-4634 ext2972
106	MCGRAW-HILL ONLINE LEARNING	123	800-823-5737
138	MICRO 2000 (RAS)	104G	800-864-8008
123	MICRO MACRO TECHNOLOGIES	130	303-320-1628
112	MICRON ELECTRONICS	CII-1	800-362-7306
*	MICROSOFT CORPORATION	12-13	
*	MICROSOFT CORPORATION	19	
*	MICROSOFT CORPORATION	28-29	
*	MICROSTAR LABORATORIES	144	425-453-2345
*	MICROWAY	75	508-746-7341
148	MINUTEMAN (IS)	CVI	972-446-7363
96	MOXA TECHNOLOGIES	146	800-699-MOXA
	N		
147	NATIONAL INSTRUMENTS (IS)	40IS 19	512-794-0100
93	NATIONAL INSTRUMENTS	144	800-433-3488
89	NEATO LLC	145	800-984-9800
*	NETWORLD+INTEROP LAS VEGAS	127	800-488-2863
119	NSTOR CORPORATION	52	800-724-3511
	O		
124	OBJECT MANAGEMENT GROUP	39	508-820-4300
*	OSBORNE MCGRAW-HILL (N.A.)	96NA 2	800-262-4729
	P		
151	PANDA SOFTWARE INTERNATIONAL (IS)	40IS 14	+34-1-332-0054**
*	PC EXPO	120	800-829-3976 ext2980
107	PKWARE INC	96	414-354-8699
128	POLYWELL SYSTEMS	141	800-300-7659
97	PRECISION GUESSWORK INC	146	508-887-6570
	Q		
108	QNX SOFTWARE SYSTEMS LTD	27	800-676-0566 ext1062
	R		
133	RAIDTEC CORPORATION	142	770-664-6066
149	RAIMA CORP (IS)	40IS 17	206-557-0200
109	RAINBOW TECHNOLOGIES (IS)	7	714-450-7300
109	RAINBOW TECHNOLOGIES (N.A.)	7	800-705-5552
95	RARITAN COMPUTER INC	146	732-764-8887**
98	RECORTEC INC	145	888-RECORTEC
129	ROSE ELECTRONICS	137	800-333-9343
	S		
139	SCEPTRE TECHNOLOGIES (RAS)	104	800-788-2878
158	SEH COMPUTERTECHNIK GMBH (IS)	40IS 22	+49-521-94226-0
153	SIEMENS NIXDORF AG PC GM5 (IS)	8-9	+49-821-8043680
99	SLIGER DESIGNS	145	800-255-0267
127	SOUTHWEST AIRLINES (N.A.)	69	
120	SPOT TECHNOLOGY	86	+886-3-587-8966
110	STATSOFT	21	918-749-1119
	T		
90	TERN INC	146	530-758-0180
131	TRI-MAP INTERNATIONAL INC	138	510-447-2030
	V		
152	VECCOM CO LTD (IS)	40IS 6	+886-3-451-5217
94	VIDEX INC	145	541-758-0521
111	VIEWSONIC	67	800-888-8583 AGENTB1109
	W		
114	WIBU SYSTEMS AG (IS)	78	+49-721-93172-22**
114	WIBU SYSTEMS AG (N.A.)	78	800-986-6578
113	WINBOOK COMPUTER CORPORATION (N.A.)	11	800-764-7285
	Z		
86	Z-WORLD ENGINEERING	144	530-757-3737

**Correspond directly with company*

*** Indicates FAX Number*

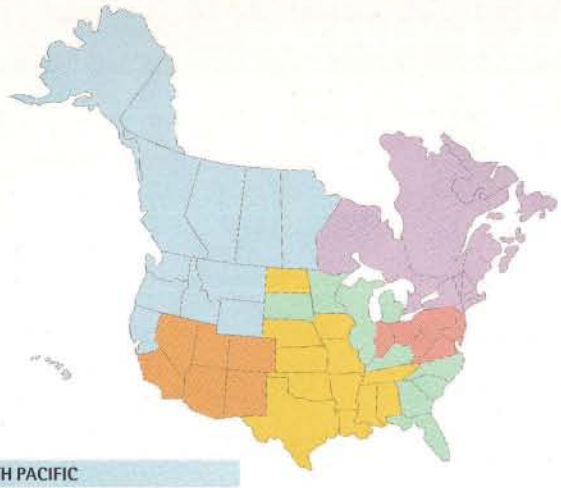
Regional Edition Definitions:
RAS – Ads only appear in Reseller Edition
EUR – Ads only appear in Europe Edition
IS – Ads only appear in International Edition
N.A. – Ads only appear in North American Edition
U.S. – Ads only appear in U.S. Edition
WORLD – Ads only appear in World Edition

BYTE ADVERTISING SALES STAFF

Michael P. Walsh, *Associate Publisher*
29 Hartwell Avenue, Lexington, MA 02173
Tel: 781-860-6714, Fax: 781-860-6179, mike_walsh@mcgraw-hill.com

Lori Silverstein, *Eastern Regional Sales Director*
921 Eastwind Drive, Suite 118, Westerville, OH 43081
Tel: 614-899-4908, Fax: 614-899-4999, lorisf@mcgraw-hill.com

Jim Hussey, *Western Regional Sales Director*
1900 O'Farrell Street, Suite 200, San Mateo, CA 94403
Tel: 650-513-6861, Fax: 650-513-6867, jim_hussey@mcgraw-hill.com



NORTH PACIFIC

AK, Northern CA, HI, ID, MT, OR, Silicon Valley, WA, WY, Western Canada
Lisa Farrell 650-513-6862
lfarrell@mcgraw-hill.com
Matt Knuth 650-513-6951
matt_knuth@mcgraw-hill.com
Sarah McGregor 650-513-6952
sarah_mcgregor@mcgraw-hill.com
Chris Litchfield 650-513-6939
The McGraw-Hill Companies
1900 O'Farrell Street, Suite 200
San Mateo, CA 94403
FAX: 650-513-6867

SOUTH PACIFIC

AZ, Southern CA, CO, NM, NV, UT
Beth Dudas 714-443-9314
bdudas@mcgraw-hill.com
Geanette Perez 714-443-9314
gperez@mcgraw-hill.com
Debra Tseng 626-447-8578
debra_tseng@mcgraw-hill.com
The McGraw-Hill Companies
635 Camino de los Mares, Suite 212
San Clemente, CA 92672
FAX: 714-443-9602

MID WEST-SOUTHEAST NEW MEDIA/ONLINE PRODUCTS

FL, GA, IL, KY, MI, MN, NC, SC, SD, WI
Neil Helms 404-843-4777
nhelms@mcgraw-hill.com
Lee Jaffe 404-843-4766
lee_jaffe@mcgraw-hill.com
The McGraw-Hill Companies
4170 Ashford-Dunwoody Road
Suite 520
Atlanta, GA 30319-1465
FAX: 404-256-5962

NEW ENGLAND/BYTE DECK

CT, MA, ME, NH, NY, RI, VT, Ontario, Canada, Eastern Canada
Edward Marecki 401-351-0274
ed_marecki@mcgraw-hill.com
Phil Marshall 978-499-0900
phil_marshall@mcgraw-hill.com
BYTE Magazine
One Richmond Square
Providence, RI 02906
FAX: 401-351-0276

PETERBOROUGH, NH OFFICE

One Phoenix Mill Lane
Peterborough, NH 03458
Sales FAX: 603-924-2683
Advertising FAX: 603-924-7507

MID ATLANTIC

DC, DE, IN, MD, Metro NY, NJ, OH, PA, VA, WV
Don Calamaro 212-512-4811
doncalamaro@mcgraw-hill.com
John Ferraro 212-512-2555
jferraro@mcgraw-hill.com
Jill Pollak 212-512-3585
jpollak@mcgraw-hill.com
The McGraw-Hill Companies
1221 Avenue of Americas, 28th Floor
New York, NY 10020
FAX: 212-512-2075

SOUTHWEST-MIDWEST

AL, AR, IA, KS, LA, MO, MS, ND, NE, OK, TN, TX
Jennifer Brinkman 214-688-5165
jen_brinkman@mcgraw-hill.com
Chrissy Copple 214-688-5171
ccopple@mcgraw-hill.com
The McGraw-Hill Companies
Mockingbird Towers, Suite 1104E
1341 W. Mockingbird Lane
Dallas, TX 75247-6913
FAX: 214-688-5167

RESELLER ADVERTISING

Beth Dudas 714-443-9314
FAX: 714-443-9602
bdudas@mcgraw-hill.com

BUYERS MART & EURO-DECK

Mark Stone 603-924-2533
stonem@mcgraw-hill.com

BYTE DECK - East Coast

Phil Marshall 978-499-0900
phil_marshall@mcgraw-hill.com

BYTE DECK - West Coast

Debra Tseng 626-447-8578
debra_tseng@mcgraw-hill.com

ADVERTISING PRODUCTION

Advertising/Production
FAX: 603-924-7507
Advertising Production Manager:
Linda Fluhr 603-924-2551
lfluhr@mcgraw-hill.com
Senior Advertising Production Coordinator:
Lyda Clark 603-924-2545
lclark@mcgraw-hill.com
Advertising Production Coordinator:
Karen Cilley 603-924-2557
kcilley@mcgraw-hill.com
Senior Operations Coordinator:
Lisa Jo Steiner 603-924-2540
lisajo@mcgraw-hill.com
Advertising Graphics Manager:
Susan Kingsbury 603-924-2507
suekings@mcgraw-hill.com

MARKETING AND PLANNING

Marketing Director:
Mary Doyle 781-860-6283
FAX: 781-860-6307
mary_doyle@mcgraw-hill.com
Market Information Manager:
Edward Fielding 781-860-6344
FAX: 781-860-6822
fielding@mcgraw-hill.com
Market Information Coordinator:
Dylan DiGregorio 781-860-6267
FAX: 781-860-6822
digregor@mcgraw-hill.com
Assistant Manager, Trade Shows and Special Events:
Arja Neukam 781-860-6378
FAX: 781-860-6307
aneukam@mcgraw-hill.com
Marketing/Sales Information Associate:
Susan Monkton 603-924-2618
smonkton@mcgraw-hill.com
FAX: 603-924-2602
Marketing Services Coordinator:
Kate Woodhouse 781-860-6361
FAX: 781-860-6307
woodhous@mcgraw-hill.com

SUBSCRIPTIONS

Customer Service
U.S. 1-800-232-2983
Outside U.S. +1-609-426-7676
For a New Subscription
U.S. 1-800-257-9402
Outside U.S. +1-609-426-5526

INTERNATIONAL ADVERTISING SALES STAFF

Lori Silverstein, *International Sales Director, 921 Eastwind Drive, Suite 118, Westerville, OH 43081 U.S.A.*
Tel: +614-899-4908, Fax: +614-899-4999, lorisf@mcgraw-hill.com

BYTE ASIA-PACIFIC AUSTRALIA, HONG KONG, INDIA, INDONESIA, KOREA, MALAYSIA, PAKISTAN, PHILIPPINES, OTHER ASIA AND PACIFIC COUNTRIES, SINGAPORE, TAIWAN

Weiyee In
weiin@dev5.byte.com
Jennifer Chen
jennchen@mcgraw-hill.com
#305 Nanking East Road,
Section 3, 10th floor
Taipei, Taiwan, R.O.C.
Tel: +886-2-715-2205
FAX: +886-2-715-2342

KOREA

Young-Seoh Chinn
JES Media International
6th Fl., Donghye Bldg.
47-16, Myungil-Dong
Kangdong-Gu
Seoul 134-070, Korea
Tel: +82-2-4813411
FAX: +82-2-4813414

GERMANY, SWITZERLAND, AUSTRIA

Jürgen Heise
jheise@mcgraw-hill.com
The McGraw-Hill Companies
Adam-Berg-Str. 115a
D-81735 Munich, Germany
Tel: +49 -89-680701-16
FAX: +49-89-680701-18

ISRAEL

Dan Aronovic
rhodanny@actcom.co.il
DARA International
11 Hasheldag Street
P.O. Box 2335
Kadima 60920, Israel
Tel: +972-9-8995813
FAX: +972-9-8995815

JAPAN

Akiyoshi Kojima
Japan Advertising Communications, Inc.
Three Star Building
3-10-3 Kanda Jimbocho
Chiyoda-ku, Tokyo 101 Japan
Tel: +81 3 3261 4591
FAX: +81 3 3261 6126

ITALY, FRANCE, SPAIN, PORTUGAL, SCANDINAVIA

Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN, England
Tel: +44 171 2843171
FAX: +44 171 2843174

Emanuela Castagnetti
emanuela.a-z@wanadoo.fr
A-Z International Sales Ltd.
BP18 Les Bossons
31 rue du Lyret
74400 Chamonix, France
Tel: +33 (0)4 50 531339
FAX: +33 (0)4 50 531368

UNITED KINGDOM, BENELUX

Jonathan McGowan
jonmcgow@mcgraw-hill.com
Tel: +44 171 495 6781
Darren Sharp
Tel: +44 171 495 6780
The McGraw-Hill Companies
34 Dover St.
London W1X 4BR
England
FAX: +44 171 4956734

EDITORIAL INDEX

For more information on companies covered in articles in this issue, enter the HotBYTEs number in the HotBYTEs form on the BYTE Web site at http://www.byte.com/hotbytes/. Page numbers refer to the first page of the article in which the company appears.

FREE Product Information Service: www.byte.com/hotbytes/

HOTBYTES NO.		PAGE NO.
	A	
1074, 1075	AccelGraphics	112
	Acorn	40IS 7
988	Adder Technologies	40IS 18
	Adobe Systems	58
	Aesop	40IS 3
	AINS	40IS 7
	Animation Science	40IS 3
1029	Apex Software	153
	Apple Computer	79
	Applied Spectral Imaging	40IS 3
	ArborText	58
	Ardent Software	101
1013	Artecon	153
	ASCI Blue Pacific Program	73
1021	AT&T	153
1076, 1077, 1078	ATI Technologies	112
1070	Atto Technology	153
1031	Axent Technologies	153
	B	
1026	Bay Networks	153
	Bellstein Informationssysteme	40IS 3
	Bull CP8	40IS 3
	C	
1057	Caldera	106
	Calluna Technology	40IS 3
	C:Direct	40IS 7
1001	Chase Technology	40IS 18
1060	Citrix Systems	43
1073	Compaq Computer	41
	CoWare	40IS 3, 40IS 11
1079	Creative Labs	112
995	C2C Systems	40IS 18
	Cygron Research and Development	40IS 3
	D	
	DB Networks	40IS 15
1080, 1081, 1082	Diamond Multimedia Systems	112
998	Digicorp	40IS 18
1055	Digital Equipment	14, 106
	Digital Vision	40IS 3
	DirectPC	40IS 7
	E	
	Eastman Software	104C
977	Eicon Technology	40IS 18
	Elan Informatique	40IS 3
1083, 1084, 1085	Elsa	112
	Emultek	40IS 3
	Eonic Systems	40IS 11
	ESM	40IS 7
	EtnoTeam	40IS 11
1047	Executive Software	129
	F	
	F&H	40IS 3
986	Freecom Computer Peripherie	40IS 18
	G	
1036	Geac Computer Systems	153
	GemPlus	40IS 3
1025	GoldMine Software	153
	Grapisoft	40IS 3
	Grif	58
	H	
992	H.E.I. Informationssysteme	40IS 18
1086, 1087	Hercules	112
1014, 1017, 1056, 1072	Hewlett-Packard	41, 106, 153
	HighGround Systems	104C
991	Hitachi	40IS 18
1010	Hitachi PC	153
	Hyperstone	40IS 11
	Hyperwave	40IS 3
	I	
	IBM	14, 24
	IMEC	40IS 11
1018	Immersion	153
1067	Influence Software	153
	Informix	87
	Institute of Electronics and Computer Science	40IS 3
	Intel	14, 24, 91, 40IS 7
	Intel TeraFLOPS Program	73
	Intellart	40IS 3
1016	Intelogis	153
1048	Interactive Magic	129
1088	Intergraph	112
	Intracom	40IS 3
	IRAM Research	73
1003	Isoft	40IS 18
	I*T COM	40IS 11
	Ivee	40IS 3
	J	
	JavaSoft	53
1089	Jazz Multimedia	112
1020	JetForm	153
	L	
978	Lasat	40IS 18
	LCI-SmartPen	40IS 3
1090, 1091	Leadtek Research	112
	LSI Logic	49
1034	Lucent Technologies	153, 40IS 15
	M	
	Macromedia	58
1015, 1092	Matrox	112, 153
	MediaNet	40IS 7
1024	Metacreations	153
	Metaphor System	40IS 3
	Metrowerks	79
1069	Micron	153
1059, 1061, 1062, 1064	Microsoft	14, 43, 47, 58, 70, 106, 121, 128, 104C, 104K
	MidCore	24
1050	Mijenix	129
	Mimer Sysdeco	87
	Mindscape	24
980	Motion Media	40IS 18
	N	
	NASA's PETA Program	73
	National Datacomm	40IS 15
1008	NEC Computer Systems	153
	NetChannel U.K.	40IS 7
994	NetcPlus Internet Software	40IS 18
	Netscape	58
976	Network Alchemy	40IS 18
1011	Nimantics	153
1049	Nolo Press	129
1030	Nombas	153
1052, 1063	Novell	44, 126, 104C
1012, 1093	Number Nine Visual Technology	112, 153
	O	
	OMG	55
1094	Omnicomp Graphics	112
	P	
997	Pericom Software	40IS 18
	Philips Data Broadcasting	40IS 7
	Philips Magnetic Heads and Modules	40IS 3
	PixTech	40IS 3
985	The Plasma Screen	40IS 18
	Plustech	40IS 3
1066	Precept Software	121
	R	
	Ramp Networks	24
	Recognita	40IS 3
981	R.N.D. Networks	40IS 18
	S	
1032	Security 7	153
	Sequent	14
983	SHE Computertechnik	40IS 18
1002	Siemens A & D	40IS 18
1033	Silicon Graphics Computer	153
	Silux	40IS 3
	Simone Research Group	40IS 3
	Sitara Networks	125
1004	Softa	40IS 18
1005	Softimage	153
1065	StarBurst Communications	121
1095, 1096	STB Systems	112
	Steinbels Transferzentrum	40IS 3
1068	S3	153
1071	Storage Dimensions	153
1019, 1058	Sun Microsystems	14, 45, 106, 153
	Sybase	87
1097, 1098, 1099	Symmetric	112
	Syskonnect	40IS 11
	T	
	Target Compiler Technologies	40IS 3
	Tecoplan	40IS 3
1023	Template Graphics Software	153
993	TenFour	40IS 18
	3Com	24
1009, 1053	Toshiba Computer	153
1022	Traveling Software	153
	V	
1007	Viewsonic	153
	Visual Tools	40IS 11
	X	
999	Xara	40IS 18
	Z	
	Z-Com	40IS 15

IS pages appear only in the International edition. C and K pages appear only in the Reseller edition.

www.byte.com

What's New

Hardware

Notebooks aplenty, 3-D tools, multi-Pentium servers, VPNs for rent, and an NT-based video-editing workstation.

PREVIEW

Toshiba Satellite Pro 480CDT
$3999

Enter HotBYTEs No. 1053.

Toshiba Computer Systems Division
Irvine, CA
800-334-3445
http://www.computers.toshiba.com.

A Portable for the Real World

Notebook vendors are vying for your attention with ultrathin or ultralight laptops, tiny subnotebooks, or portables with brilliant 14-inch screens. While Toshiba's Satellite Pro 480CDT is none of those things, it is a safe, competent choice.

Starting at $3999, the 480CDT comes with a 233-MHz Pentium with MMX. It also has a 256-KB Level 2 cache and 32 MB of EDO RAM (expandable to 160 MB). The unit's 12.1-inch 800 × 600 TFT active-matrix color LCD has a narrow viewing angle but is a very capable screen. With two excellent built-in stereo speakers, the 480CDT becomes a competent multimedia machine. USB, parallel, serial, and infrared ports, as well as a 240-pin connector for port replication, offer the functionality a portable needs. Connections for SVGA video, PS/2 mouse, microphone, headphone, in-line jacks, and cellular round out the system's list of standard interfaces.

The unit measures 11.9 inches wide by 9.4 inches deep by 2 inches high and weighs 6.9 pounds, a workable size for use in a business-class airplane seat. Its case is sturdy, although it has a number of small plastic doors and hinges that seem prone to breaking. A 3.82-GB hard drive is standard, along with a 10X CD-ROM drive; like other Toshiba laptops, it has no internal floppy, but it does come with an external drive.

Until vendors find the ideal, next-generation form factor for laptops, a system like the Toshiba Satellite Pro 480CDT is an excellent choice for a complete, midrange portable. **–Jason K. Krause**

PHOTOGRAPH: STEVEN GREENBERG © 1998

Graphics Cards

3-D Gets a Dose of Reality

NUMBER NINE'S 9FX REALITY 334 graphics accelerator is a midrange ($129) add-in card with a full set of 3-D features and 64-bit 2-D graphics acceleration. The card works with PCI or systems built around Intel's LX440 AGP chip set. The card, which comes equipped with 4 MB of 100-MHz SGRAM graphics memory, delivers MIP mapping, trilinear filtering, perspective correction, and Z-buffering, as well as other 3-D rendering capabilities. It supports Windows NT's dual-monitor environment and includes Number Nine's Hawk-Eye display-control utility for adjusting image quality.
Contact: Number Nine Visual Technology, Lexington, MA, 800-438-6463 or 617-674-0009; http://www.nine.com.
Enter HotBYTEs No. 1012.

Sparc System

Sun Workstations for Less

NOT ALL HIGH-END APPLICATIONS DEMAND ultrahigh-end workstations. Sun's new Ultra 5, priced under $5000, is a 270-MHz UltraSPARC IIi-based system. It comes with 64 to 512 MB of ECC RAM, a 4-GB disk drive, three PCI I/O slots (33-MHz, 32-bit), and 8-bit integrated graphics; 24-bit graphics add-ins are also available. This midrange workstation targets applications like software development, finance, databases, or digital-content creation—applications that demand the speed of a workstation but don't need peripherals aimed at animation or MCAD.
Contact: Sun Microsystems, Menlo Park, CA, 650-960-1300; http://www.sun.com.
Enter HotBYTEs No. 1019.

Notebooks

If Kate Moss Were a Notebook

THIN IS IN, AND NEC'S VERSA 5080, AT 4.9 pounds and 1.5 inches thick, is a power user's full-featured laptop with a waifish form factor. The new

Versa has a 233-MHz Pentium with MMX mobile processor from Intel and comes with a 12.1-inch SVGA TFT or a 13.3-inch XGA TFT screen, up to 4 GB of hard drive space, 20X CD-ROM drive, and 16 to 144 MB of RAM. Prices start at $3700.
Contact: NEC Computer Systems, Mountain View, CA, 650-528-6000; http://www.nec.com.
Enter HotBYTEs No. 1008.

A Desktop in a Laptop

THE LINE BETWEEN PORTABLES AND DESKTOP systems is blurred by machines like Toshiba's Tecra 550CDT. For around $4000, this laptop offers desktop features like a 266-MHz Pentium with MMX, 3.83-GB hard drive, up to 160 MB of EDO RAM, and 4 MB

of SGRAM video memory. It runs for an estimated 3.5 hours on battery and has a hot-swappable secondary 2-GB hard drive, plus a voice/fax/data K56Flex modem for demanding use on the road.
Contact: Toshiba America Information Systems, Irvine, CA, 714-583-3000; http://www.computers.toshiba.com.
Enter HotBYTEs No. 1009.

Monitors

Unobtrusive LCD Monitor

VIEWSONIC'S 15-INCH LCD MONITOR, THE VPA150 ViewPanel ($2450), can display full 8.5 × 11-inch pages. Its viewing area is comparable in

height to a 21-inch CRT monitor, but the unit has a mere 6.7-inch profile, 12.8-pound weight, and 40-watt power consumption. It has a resolution of 1024 × 768 and a refresh rate of 75 Hz.
Contact: ViewSonic, Walnut, CA, 800-888-8583 or 909-869-7976; http://www.viewsonic.com.
Enter HotBYTEs No. 1007.

Subnotebooks

Big CPUs Come in Small Packages

NIMANTICS' PERSONA T-150 IS POSSIBLY the most powerful subnotebook available today. A 150-MHz Pentium processor with MMX, an 8.4-inch TFT active-matrix color screen, and up to 80 MB of EDO RAM make the 2-pound system a functional alternative to full-size notebooks. Priced between $2399 and $2999, it has a full 15.1-mm horizontal key travel, large enough for touch-typists to be comfortable, and includes an external floppy drive and up to 1.6 GB of hard drive space.
Contact: Nimantics, Tustin, CA, 888-664-6268 or 714-440-8164; http://www.nimantics.com.
Enter HotBYTEs No. 1011.

The Little Notebook That Can

SMALL ENOUGH TO FIT IN A BRIEFCASE OR purse, Hitachi's VisionBook Traveler is as powerful as some full-size notebooks. Its CPU is the mobile 133-MHz Pentium processor with MMX. The notebook weighs 2.7 pounds and measures 9.2 inches wide by 6.8 inches deep by 1.3 inches high. The 8.4-inch TFT active-matrix screen is wide enough to display a standard word processor page. With 8 to 40 MB of RAM, 1-GB hard drive, and external floppy, it has sufficient storage for portable computing, although no CD-ROM drive is currently available.
Contact: Hitachi PC (USA), Milpitas, CA, 800-555-6820 or 408-321-5000; http://www.hitachipc.com.
Enter HotBYTEs No. 1010.

Servers

It's Raining CPUs

NCR HAS LINKED TWO FOUR-PROCESSOR boards to give its WorldMark 4380 the strength of eight Pentium Pro processors. The server is capable of

hosting large-scale electronic commerce and Internet applications, a data warehouse, or a thin client environment. Prices range from $17,900 to $60,000. It is based on the 200-MHz Pentium Pro with 512 KB or 1 MB of cache per CPU. The system comes loaded with Windows NT and NCR's SMP Utilization Manager for consolidating it with other NT servers.
Contact: NCR, Dayton, OH, 800-225-5627 or 937-445-5000; http://www.ncr.com.
Enter HotBYTEs No. 1006.

Give Your Server a Free Hand

THE MICRON MV5000 I2O SERVER, BUILT around Intel's MB440LX server platform with the i960 RD I/O processor and dual Symbios Logic PCI Ultra SCSI controllers, offers enhanced processing power by offloading I/O and RAID functions from the host processor. This leaves the Pentium II CPU free to handle your high-end server applications. A base configuration comes with a single Pentium II (a dual-processor model is also available), 2-GB Ultra-Wide SCSI-3 hot-swappable SCA hard drives, and 32 MB of ECC SDRAM. Price is $5059.
Contact: Micron Electronics, Nampa, ID, 800-776-4518 or 208-898-3434; http://www.micronpc.com.
Enter HotBYTEs No. 1069.

RAID

Keep Your Backup Covered

ARTECON'S LYNXARRAY NOW GIVES ENTERprise networks up to 162 GB of backup RAID protection with 18-GB hot-swappable drives. These new drives employ IBM's magnetoresistive-extended head technology, giving them a 3.5-inch form factor. A 162-GB system with nine 18-GB disks is $64,995. LynxArray RAID systems are also available with 9-GB or 4-GB drives.
Contact: Artecon, Carlsbad, CA, 619-932-5500; http://www.artecon.com.
Enter HotBYTEs No. 1013.

Entry-Level LAN Storage

STORAGE DIMENSIONS' 9.1-GB, 7200-rpm RAIDPro disk drives afford a PC LAN up to 45.5 GB of fault-toler-

ant storage with up to 64 MB of cache. It has a footprint the size of a legal pad and is only 6 inches high. Prices start at $7818.
Contact: Storage Dimensions, Milpitas, CA, 408-954-0710; http://www.storagedimensions.com.
Enter HotBYTEs No. 1071.

Scanners

Scanning Made Easy

THE HP SCANJET 5100C COLOR SCANNER reduces the scanning learning curve by automatically sharpening, adjusting, and tweaking anything you input. The unit costs $299 and includes Hewlett-Packard's Intelligent Scanning Technology, which adjusts the resolution for different individual elements on a page, like text, photos, line art, or logos, while automatically realigning images if they are scanned at an odd angle.
Contact: Hewlett-Packard, Palo Alto, CA, 800-527-3753 or 650-857-1501; http://www.hp.com.
Enter HotBYTEs No. 1014.

Mice

Mice Have Feelings, Too

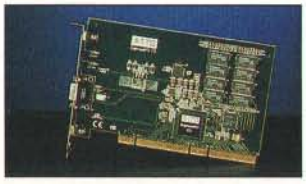
THE FEELIT MOUSE ($139) SIMULATES what it might feel like if your user interface had a three-dimensional, tactile surface. It pushes back

against your hand to approximate the sensation of textured backgrounds, the weight of a folder as you drag it across the screen, or your cursor bumping into the edge of the user interface. The Feelit mouse is already integrated into Windows 95 and allows you to customize how you want your desktop interface to feel. The software API is available for programmers who want to develop custom sensations for applications.
Contact: Immersion, San Jose, CA, 408-467-1900; http://www.force-feedback.com/feelit/feelit.html.
Enter HotBYTEs No. 1018.

PCI Host Adapter

The Fibre Channel Expressway

THE EXPRESSPCI FC ($995) IS A 64-BIT PCI bus Fibre Channel adapter with the ability to host up to 126 devices



on an arbitrated loop. Designed for I/O- and data-intensive applications, the ExpressPCI FC provides full-duplex 1.06-gigabit Fibre Channel performance, Atto says. The card has Media Interface Adapter-compliant ports for quick connections to copper cabling and fiber-optic cables.
Contact: Atto Technology, Amherst, NY, 716-691-1999; http://www.attotech.com.
Enter HotBYTEs No. 1070.

Networking

Fibre Channel Controllers

BY COMBINING 64-BIT PCI WITH ITS OWN Tachyonic architecture, Hewlett-Packard has made the TachLite IC ($150) an affordable Fibre Channel controller for building mass-storage systems. It provides throughput of 100-MBps and 10,000 I/O per second.
Contact: Hewlett-Packard, Palo Alto, CA, 800-537-3753 or 650-857-1501; http://www.hp.com.
Enter HotBYTEs No. 1017.

The Road to Bandwidthville

MATROX'S LATEST 100BASE-TX REPEATER hubs extend LAN capabilities with Fast Ethernet integration and up to 144 ports in a stackable architecture. The Fast Hub 8 ($499), Fast Hub 16 ($899), and Fast Hub 24 ($1299) offer 8, 16, and 24 ports. An MDI uplink port on each hub connects additional repeater hubs or switches, so you don't have to waste a port when adding a new hub to your network.
Contact: Matrox, Dorval, Quebec, Canada, 800-837-3611 or 514-969-6080; http://www.matrox.com.
Enter HotBYTEs No. 1015.

Ubiquitous Network Connection

YOU MAY KNOW THAT IT'S POSSIBLE TO RUN a network over the same wires that bring electricity to your toaster. Intelogis' Passport is a file/printer-sharing system that takes advantage of this possibility, delivering 350-Kbps throughput to small offices or

homes that need simple networking. Just plug one end of the unit into a parallel port and the other into the wall, install Intelogis' client software, and you can see workgroup networks through Windows Explorer. Prices for Passport products range from $49.99 to $239.99.
Contact: Intelogis, American Fork, UT, 888-756-5199 or 801-756-5199; http://www.intelogis.com.
Enter HotBYTEs No. 1016.

SOFTWARE
Work Flow

Make Work-Flow Work for You

INTEMPO, JETFORM'S WORKFLOW/ELECTRONIC-forms solution for native Windows, HTML, and Java-based clients, can reduce the time and expenses associated with traditionally paper-bound processes such as purchase requests, invoices, and expense reports. It now supports Microsoft Exchange Server 5.5 and messaging systems such as Lotus Notes, cc:Mail, SMTP/POP3, and Microsoft Mail systems. InTempo includes design tools that let users build applications graphically, plus time-based controls to improve expediency. The server component runs on NT. Prices vary depending on how many participants you have, but you can expect to pay $20,000 for 100 users.
Contact: JetForm, Ottawa, Ontario, Canada, 800-JET-FORM or 613-230-3676; http://www.jetform.com.
Enter HotBYTEs No. 1020.

Networking

Rent a Virtual Private Network

END-TO-END SERVICE GUARANTEES, A HIGH-performance IP backbone, and customer service support is more than many people expect of their networks, but that is what AT&T promises with the WorldNet Virtual Private Network. It's a service offering a VPN based on AT&T's own IP backbone, which can add frame relay networks, intranets, and extranets to your corporate LAN. The company claims the backbone is engineered for 99.7 percent network uptime, with dial-up access for remote users and planned international access from 35 countries. AT&T says it will offer guaranteed service to subscribers in 1998. Charges range from $103 for a 16-Kbps connection to $2366 for 1024-Kbps managed connections per month, with local dial access for $3 per hour or at a negotiated flat rate.
Contact: AT&T, 800-831-5259; http://www.att.net/worldnet.
Enter HotBYTEs No. 1021.

Work in Your Underwear

WORKING AT HOME OUGHT TO BE A VIABLE alternative to working in the office. Remote DeskLink from Traveling Software, priced under $50, automatically configures your home PC's modem and network devices for remote communications. The software supports TCP/IP or IPX networks and Windows 95 Dial-Up Networking for remote access to a PC at the office.
Contact: Traveling Software, Bothell, WA, 800-343-8080 or 425-483-8088; http://www.travsoft.com.
Enter HotBYTEs No. 1022.

3-D Drawing

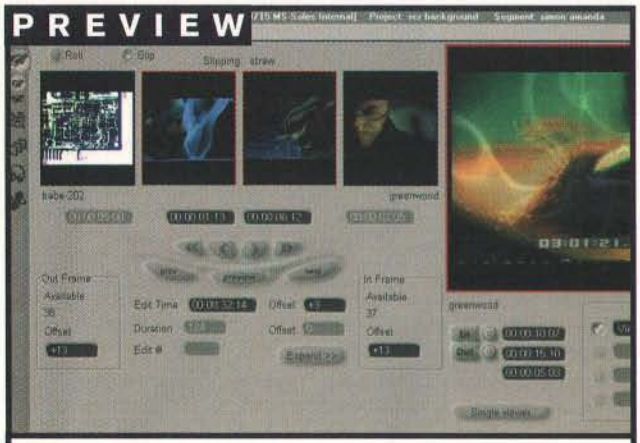
E-Z 3-D

3SPACE PUBLISHER ($129) IS A NEW ENTRY-level desktop tool designed for novice users to create 3-D images and animations. It has a simple drag-and-drop interface. The package includes templates with over 1000 predrawn objects and textures and can create shadows, reflections, fog, and other effects automatically. It offers 3-D VRML support; can automatically create animated GIF, VRML, and Java applets; and can handle video, JPG, BMP, and TGA files.

Contact: Template Graphics Software, San Diego, CA, 619-457-5359; http://www.tgs.com.
Enter HotBYTEs No. 1023.

Bryce Gets Animated

BRYCE 3D, FORMERLY A 3-D IMAGE CREation tool for two-dimensional print media, has been refurbished by MetaCreations as a 3-D animation tool for QuickTime or AVI formats. Bryce 3D costs $299 and gives animators tools for creating lighting and textures, plus updated atmospheric effects like rainbows that simulate actual water vapor refraction, volumetric properties for more realistic atmospheres, and random star-pattern generation.
Contact: MetaCreations, Carpinteria, CA, 805-566-6200; http://www.metacreations.com.
Enter HotBYTEs No. 1024.



Digital Studio
$100,000

Enter HotBYTEs No. 1005.

Softimage
Montreal, Quebec, Canada
800-576-3846
514-845-1636
http://www.softimage.com

Professional Video Editing at a Professional Price

Silicon Graphics (SGI) and other companies have been breaking the wall between professional-level, purpose-built video post-production equipment and desktop systems for several years. Now, with its long-awaited Digital Studio (DS), Softimage has demolished more of that wall, moving top-quality video post-production to Windows NT workstations.

Softimage, now a subsidiary of Microsoft, has long been an SGI staple. The first and only machine DS currently ships on is a dual Pentium II/300-based modified Intergraph StudioZ video-editing workstation running Windows NT 4.0. The developers claim the program code is extremely portable, so an SGI version might yet be on the horizon, but they also proudly tout how much performance they've wrung out of MMX instructions. It is clearly an NT-friendly application, with resizable panes and standard Windows tools.

At the rollout we saw full-resolution elements of a commercial re-edited, composited, color-corrected, remixed, and played back. Many steps were done nearly in real time, with none taking more than 30 seconds, even on 80-frame sequences. However, DS doesn't include Softimage 3D, the company's flagship 3-D animation package, and it leaves out any morphing tools.

This first version of DS, fully integrated, installed on-site, and with the computer, is $100,000. Yet the price compares well with top-end compositing and D-1 on-line editing systems.

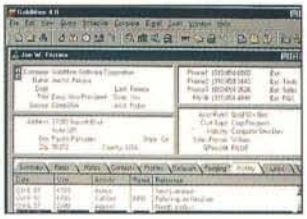
Time will tell how large Digital Studio's market in Hollywood is. But if the product's price comes way down, it could eventually compete with packages like Adobe Premiere in the news-gathering, corporate communications, and semiprofessional video markets.

– Alex Pournelle

Contact Manager

GoldMine 4.0 Digs Into SQL and dBase

TO MEET THE NEEDS OF DISTRIBUTED AND heterogeneous workgroup environments, version 4.0 of the GoldMine contact manager adds a new client/server for SQL databases ($1400). There's also a new dBase IV version of the product ($295 to $895). GoldMine can now communicate with any data source that is 32-bit ODBC-compliant. To



accommodate distributed network users, it has IP-to-IP connections for Internet replication, and it supports multiple, distributed SQL databases and POP3 messaging.
Contact: GoldMine Software, Pacific Palisades, CA, 800-654-3526 or 310-454-6800; http://www.goldminesw.com.
Enter HotBYTEs No. 1025.

The Web

Cut Download Time

GEO PUBLISHING CLAIMS ITS EMBLAZE WebCharger can compress 16- or 24-bit full-color images up to 400 percent more than JPEG can. WebCharger is JPEG-compatible, but it compresses a file before JPEG compression occurs. It defines areas in an image that can be compressed and those that should be untouched. The program won't degrade image quality, Geo says. It works with any GIF, BMP, JPEG, or PICT file.
Contact: Geo Publishing, Woodland Hills, CA, 800-576-7751 or 818-703-8436; http://www.emblaze.com.
Enter HotBYTEs No. 1027.

Security

Catch Hackers in the Act

AUDIT TRAILS ARE A GOOD WAY TO IDENTIFY illegal activity on a network, but they often waste disk space, are rarely utilized, and alert users to an intruder only after he has already gone. Intruder Alert 3.0 watches audit trails and informs network administrators in real time of illegal activity. It can detect over 100 illegal operations with no configuration necessary, and detects many more once basic parameters are set. The software deletes unsuspicious trails automatically.
Contact: Axent Technologies, Rockville, MD, 301-258-5043; http://www.axent.com.
Enter HotBYTEs No. 1031.

Gateway Guardian

SAFEGATE 1.1 ($2000 TO $9000) PROtects your network gateway(s) from Java applets, DLL and EXE files, or ActiveX components that fail to meet corporate security policies. It works on the fly and can verify digital signatures in ActiveX components.
Contact: Security-7, Boston, MA, 617-753-7380; http://www.security7.com.
Enter HotBYTEs No. 1032.

On-Line Analysis

A Reporting Tool with Less Baggage

APERIO IS AN OLAP REPORTING TOOL BUILT from the ground up with no client-side software. It resides on a Unix

or NT server and automatically turns queries to a database into HTML forms and sends them out to desktop Web browsers. The program can access reports and information from other programs like SAP R/3 or Crystal Reports (you can launch Aperio inside their client software). And because it treats reports like a Web page, you can bookmark reports, and you can drill down and then press your browser's Back button to undo an analysis. Aperio includes features for generating reports automatically. It is designed with a central management interface for governing access to reports. Aperio is priced at $20,000 for two concurrent users doing actual queries to the database and an unlimited number of users simply viewing reports. An unrestricted license is $400,000.
Contact: Influence Software, Sunnyvale, CA, 408-617-0268; http://www.influencesw.com.
Enter HotBYTEs No. 1067.

Software Updates

Cosmo Code is one of the most powerful Java programming tools around, but it has been limited by the fact that you need an SGI workstation to use it. With version 2.5 ($345), not only does it run on Windows 95 and Windows NT PCs, but it includes the latest JDK 1.1.4, a drag-and-drop WYSIWYG interface, and support for all JDK 1.1 layout styles and managers. It also comes with the Rogue Wave components JTools 2.0, JWidgets 3.0, and JCharts.
Contact: Silicon Graphics Computer Systems, Mountain View, CA, 800-800-7441 or 650-960-1980; http://www.sgi.com.
Enter HotBYTEs No. 1033.

Inferno 2.0 makes hand-held devices into networked computer systems. The OS fits itself and an application in 1.5 MB of memory so it can run on wireless phones, personal digital assistants, or intelligent set-top boxes. The latest Inferno Developer's Kit, version 2.0 ($150), includes support for Sun's Personal Java programming language, a subset of the Java language designed for network-enabled mobile products. This latest release is compatible with soft modem technology, eliminating the need for hardware modems. Basic programs can run with as little as 512 KB of RAM and 256 KB of ROM.
Contact: Lucent Technologies, Murray Hill, NJ, 888-582-3688; http://www.lucent.com/inferno/.
Enter HotBYTEs No. 1034.

netViz creates illustrations representing physical and logical views of assets across an organization. The program turns abstract data types into comprehensible graphics. Not just a drawing tool, it can access spreadsheets and SQL databases with ODBC drivers. The latest release, netViz 3.0, costs $595 and includes new database interfacing and publishing capabilities, plus a library of over 3000 symbols. You use a drag-and-drop interface for creating representations.
Contact: netViz, Rockville, MD, 301-258-5087; http://www.netviz.com.
Enter HotBYTEs No. 1035.

SmartStream 5.0 (about $60,000 per module) is a comprehensive suite of business application modules for financial, procurement, human resource, and decision-support applications. It provides Java applets within each module, including employee self-service human resource apps and Web-based procurement forms. Each module has its own set of APIs for cross-platform capabilities. The latest release is Microsoft BackOffice-compliant. It comes with applications for supplies management, and it has a system verification tool for locating bottlenecks.
Contact: Geac Computer Systems, Atlanta, GA, 404-239-2000; http://www.smartstream.geac.com.
Enter HotBYTEs No. 1036.

Internet

Instant Internet: Just Add LAN

BAY NETWORKS' INSTANT INTERNET100 connects a whole small-office LAN with either analog or ISDN access to the Internet through a single dial-up account at a single IP address. The Instant Internet100 package, a scaled-down version of the Instant Internet 400, ships with the choice of three connectivity and price options: 33.6-Kbps analog modem ($750); 56-Kbps analog modem ($950); and 128-Kbps ISDN connection ($950).
Contact: Bay Networks, Santa Clara, CA, 408-988-2400; http://www.baynetworks.com.
Enter HotBYTEs No. 1026.

3-D Graphics

Taking Advantage of 3-D

3-D GRAPHICS ARE COOL TO LOOK AT, BUT can they make you more productive? VisiDrive is a visual file manager that offers a three-dimensional user interface for navigating and managing files on your desktop. You can view multiple directories, subdirectories, and files simultaneously, making it easier to find folders without scouring through scads of windows or scrolling through traditional two-dimensional views of your files.
Contact: S3, Santa Clara, CA, 408-588-8000; http://www.s3.com.
Enter HotBYTEs No. 1068.

Programming

Take JavaScript Beyond Browsers

BY MERGING ITS SCRIPTEASE SCRIPTING language with JavaScript, Nombas' ScriptEase: Integration SDK ($995) makes it possible to integrate JavaScript into all classes of software and embedded systems. The development kit enables programmers to quickly incorporate a fully functional scripting language interpreter into any C or C++ application, the company says. It works with the major C/C++ compilers.

The package includes 200 sample wrapper functions and 80 API functions. The SDK is compliant with ECMAScript. A "pure" Java version is planned for this year.
Contact: Nombas, Medford, MA, 781-391-6595; http://www.nombas.com.
Enter HotBYTEs No. 1030.

Making Visual Basic More Intuitive

VISUAL BASIC CREATES INTUITIVE APPLICATION interfaces, and Apex's True DBList Pro 5.0 ($179.95) add-on promises to extend that capability. It features styles that mimic popular Windows applications, and it offers newly invented styles, flexible data modes, data-sensitive object color and font control, and a host of new fonts, templates, layouts, display types, search capabilities, and graphics.
Contact: Apex Software, Pittsburgh, PA, 800-858-2739 or 412-681-4343; http://www.apexsc.com.
Enter HotBYTEs No. 1029.

improbable

Advances and Retreats in Computing

A product to end wasteful voice mail, and the death of all-natural PC accessories.

Get to the Point

Voice mail wastes a huge amount of everybody's time. The main problem is people who hem and haw. Rather than leaving a brief, clear message, they ramble, they hesitate, they talk in circles.

A new product from Zapff Telephonics solves the problem. Called "Get To The Point" (GTTP), it can be added to any voice-mail system. Zapff's researchers have accumulated data on the types of things time-wasters utter when they leave pointless phone messages. Zapff then used this data to give GTTP a highly specialized voice-recognition capability. Whenever a caller starts rambling, GTTP quickly emits a noise that sounds like a referee's whistle, and then a voice cuts in on the message and says, "Get to the point. You have 10 seconds." Ten seconds later, GTTP terminates the connection. Anything said prior to the warning is discarded, and an antiredundancy circuit disconnects the call if the same person calls again within the next 12 hours.

Tests indicate that if GTTP were installed in every current voice-mail system, it would free up nearly as much phone bandwidth as has been soaked up in the past decade by fax machines and Internet connections combined.

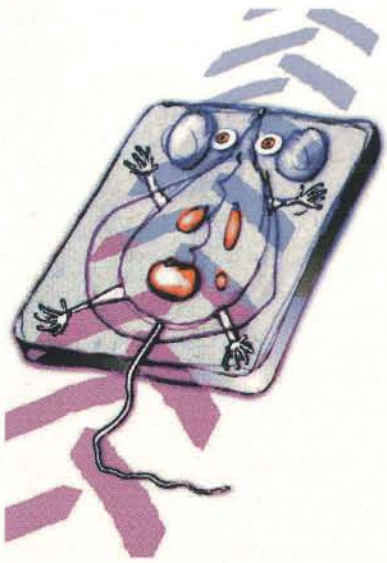
Recycling Scandal

The mouse-pad recycling industry is now kaput. Hand-To-Mouse, Inc., the San Jose–based animal-breeding laboratory that was the lone supplier of the raw materials used in the mouse-pad recycling industry, has closed its doors.

Hand-To-Mouse's Soothe-a-Mouse was the first computer accessory to be made from an actual animal carcass. It inspired fanatic, albeit not universal, acclaim. Those who liked it loved it, fondly caressing their little Soothe-a-Mouses all day long.

The company also did well with its Rug-a-Pad mouse pads. They were smooth and silky, and they looked for all the world like tiny bearskin rugs. Carpal-tunnel syndrome sufferers still swear by them. You can rest your wrist on the furry little head, removing any strain from the over-stressed tendons of your hand and forearm.

Hand-To-Mouse's downfall started when the company foolishly advertised the product as being made from "artificial materials." That untruth was the company's undoing. There's a market for all-natural products, and that market does not like being lied to. In addition, some Rug-a-Pad users were grossed out when they learned the true nature of its ingredients. The ensuing protests killed off an entire (very promising) product category. The Rug-a-Pad's working surface, made from vulcanized, ground mouse innards, is still the most efficient traction material ever put on the market.



Thus, real-mice components are now toast, and the whole Hand-To-Mouse affair will become just another dimly remembered Silicon Valley scandal. It's one more smudge on an industry that was once the very model of innocence and compassion.

Marc Abrahams is the editor of the Annals of Improbable Research. *You can contact him by sending e-mail to* **marca@improb.com.**

ILLUSTRATIONS: 3VictoR GAD2 © 1998

If you really care for your software protect it.

SMARTKEY THE INTELLIGENT SOFTWARE PROTECTION.

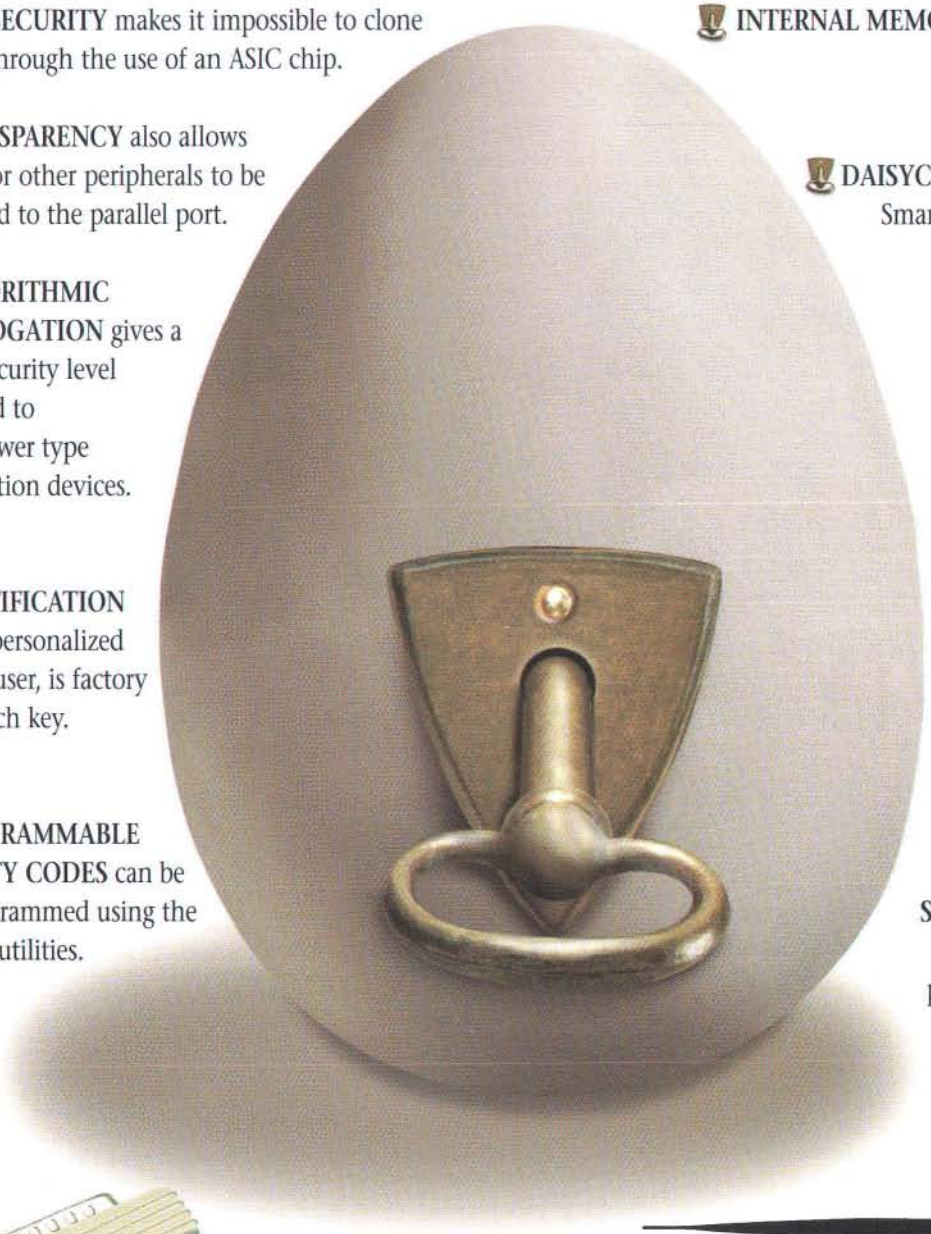
TOP SECURITY makes it impossible to clone the key through the use of an ASIC chip.

TRANSPARENCY also allows printers or other peripherals to be connected to the parallel port.

ALGORITHMIC INTERROGATION gives a higher security level compared to fixed-answer type interrogation devices.

IDENTIFICATION CODE , personalized for each user, is factory set on each key.

PROGRAMMABLE SECURITY CODES can be user-programmed using the supplied utilities.



INTERNAL MEMORY holding up to 416 bytes of read-write non-volatile memory.

DAISYCHAIN enables up to 20 SmarteyKey and more to be installed on a same parallel port.

ANTIVIRUS FUNCTIONS are implemented through the automatic encryption supplied.

DATA PROTECTION is allowed through the encryption of data files associated with the protected applications.

COMPLETE SOFTWARE is provided for manual and shell protection from DOS to WIN NT and UNIX.

Eutron

COMPUTER SECURITY SOLUTION

EUTRON spa Bergamo
Tel. +39-35-697011
e-mail info@eutron.com
Fax +39-35-697092
Internet http://www.eutron.com

BRASIL - BELGIUM - BULGARIA - CROATIA - FRANCE - FINLAND - GREECE - HUNGARY - LUXEMBURG - POLAND - SLOVENIA - SWEDEN - THE NETHERLANDS

And Your Country?

Enter HotBYTEs No. 145 at http ://www.byte.com/hotbytes/

What happens if you don't install a Minuteman UPS.

FREE
QUICKPICK
UPS SIZING SOFTWARE
www.minuteman-ups.com

DISTRIBUTOR & RESELLER OPPORTUNITIES AVAILABLE

XRT Series

You may need a place to hide when a power outage or power surge knocks out your telecom or network system.

Wait until somebody discovers how easy — and inexpensive — it would have been to protect the entire system with a MINUTEMAN uninterruptible power supply (UPS) and power management software. Talk about not wanting to be found.

MINUTEMAN's award winning product line meets all your power protection requirements. Our XRT (eXtended Run Time) line offers unlimited backup times for mission critical communication systems. Members of our Pro Series protect network components, workstations, and data lines. And we make it easy to select the be MINUTEMAN UPS for your application — just visit our web site.

MINUTEMAN offers another big advantage — our proven pow management software. Its warning and diagnostic tools exter protection. And it provides for safe, unattended shutdowns that prote data and equipment.

Make sure your entire system is protected with a MINUTEMA uninterruptible power supply. That way, instead of hiding under a desk, you'll be on top of the world.

Pro Series

MINUTEMAN UPS • 1455 LeMay Drive • Carrollton, TX 75007 • +1 972-446-7363 • Fax +1 972-446-9011 • 24 Hour Info via Fax +1 972-664-3833

MINUTEMAN
UNINTERRUPTIBLE POWER SUPPLIES

HotGuide BEST BUY · COMPUTER SHOPPER THE TOP 100 · TELECONNECT Editors' Choice · TELECONNECT Product of the Year 96

800-238-7272
www.minuteman-ups.com/byte.htm

Enter HotBYTEs No. 148 at http ://www.byte.com/hotbytes/